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CEMENT
.....AND.....
ENGINEERING NEWS

A View of San Francisco's New Buildings.

In Their Construction Concrete Has Been Used to a Predominating Extent.

CEMENT AND ENGINEERING NEWS

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JOHN F. WALDRON, Advertising Manager

CHICAGO, JANUARY, 1909.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all its branches Engineering notes, public improvements, and facts and opinions drawn from practical experiments will be welcome.

Cement Products Exhibition Co., 2nd Annual Cement Show, February 18 to 24, 1909, at the Coliseum, Chicago.

Northwestern Cement Products Association Exposition, March 2, 3, 4, 1909, at The Armory, Minneapolis, Minn.

IMPROVEMENTS IN CONCRETE PRODUCTS AND MACHINERY.

There has been a decided advance in concrete specialties during the year tending to more artistic effect without sacrificing strength and utility. Cement is being more generally used. Effects in finished surfaces, equal and even surpass high grade cut and rubbed stone work. There are polished surfaces in concrete that cannot be surpassed in marble and granite, either in variegated color tints or polished surfaces, and that are as durable as the natural stone, and that can be used for floor tiles, wainscoating and panel effects, and columns, such as may be seen in the decorations of first class hotel lobbies. True the same effects can be produced in magnesite cement ware products composed in the main of magnesia and a solution of epsom salts mixed with a few other ingredients. This magnesite product, while it satisfies the eye does not retain the luster in the presence of moisture, and it likewise throws off a gas in and perceptible odor. We warn our readers against investing money or taking any interest in the manufacture of this product, as it is simply a delusion and snare used by the promotor to entrap the uninitiated capitalist and cement worker.

Cement drain tile machinery has been greatly improved. The Baldwin cement tile machine operated at the National Association of Cement user's exhibition at Cleveland, by the Miracle Pressed Stone Co., with 7 men is capable of forming from 3,000 to 4,000, 4 to 12 inch drain tile in ten hours. One yard of concrete 4 in 1 mixture will produce 480 four inch tiles or 96 twelve inch tiles, at a less cost than clay tile can be laid down in the trenches. The fuel for burning is constantly advancing, while the cost of concrete has been downward when used in rough finished work.

There has been some advance in labor saving machinery for handling and mixing concrete power tampers. Concrete block machines are becoming less complicated. The fad machines are rapidly disappearing. There are fewer cement block machine manufacturers on the market at present than a year ago. The purchasers of concrete machinery are becoming more cautious and more discriminating each year, consequently the reliable manufacturers are picking up the bulk of trade; this means that experience counts.

A CORRECTION.

In the article in our December issue, we stated that the kilns in the new Superior Portland Cement mill at Baker, Wash., were furnished by the Power and Mining Machinery Co., which was an error. These kilns were furnished by W. F. Mosser & Son of Allentown, Pa.

Come to the Cement Products Exhibition Co.'s Cement Show at Chicago February 18 to 24, to be held at the Chicago Coliseum.

The Wawassee Protective Association composed of resorters, pleasure seekers who fish in Lake Wawassee where the Sandusky Portland Cement Company operate dredges for marl used in the manufacture of cement are seeking legislation to prevent the Cement Co. from working its dredges on the lake on account of destroying the fish in the lake. A bill to effect the wishes of the resorters, was introduced at a previous session of the legislature of Indiana. This bill was tabled without appearing, a similar bill is to be presented at the next session of the legislature backed by a regular organized lobby.

There is little danger of the Sandusky Portland Cement Company being disturbed in its vested interest in Lake Wawassee by these busy bodies.

THOMAS A. EDISON'S PREDICTION.

The next 20 years will mark the most wonderful period in science and invention, that the world has ever known, so vast will the advance be that we can scarcely have any conception of its scope, already a great many of the inventions of the future are assured. It is only of those that I regard as practical certainties that I mention here, says Thomas A. Edison in the New York Times.

1st within the next 20 or 30 years, commencing within the next 2 or 3 years, concrete architecture, will make enormous forward strides: The art of molding concrete will be reduced to such a high state of perfection and cheapness, that the man who is earning $1.50 per day, with a family to support, will be better housed than the man of to-day who is earning $10 a day. Many gifted architects will rise up and through their efforts cities and towns will spring up in this country beside which Turner's picture of ancient Rome and Carthage will pale into nothingness and the building of the Columbian exposition will appear common. But great expense will not attend this; it will be done so that the poor will be able to enjoy houses more beautiful than the rich now aspire to.

2. Moving-picture machines will be so perfected that the characters will not only move, but will speak, and all the accessories and effects of the stage will be faithfully produced on the living-picture stage. This, of course, will not be done as well as on the regular stage, but its standard will approach very near to that, and the fact that such entertainment will be furnished for 5 cents will draw vast numbers of the working classes. The result will be that the masses will have the advantage of the moral of good drama, they will find an inexpensive and improving way of spending the evening and the death knell of the saloon will be sounded.

3. In perhaps fifteen or twenty years—depending on the financial condition of the country—the locomotive will pass almost altogether out of use and all our main trunk railways will be operated by electricity.

The concrete sea wall at San Francisco extending from Mission St. to Jones St., on the water front has settled from three to five feet in places, causing large depressions in the street in the street opposite the sunken portions of the wall. The present sea wall is built by digging a trench and depositing a foundation of broken stone upon which the sea wall was erected, at a cost of $2,500,000. The state engineer who examined the work says the wall should have been carried on pile foundations. The repairs to the wall will cost $500,000.

Come to the Cement Products Exhibition Co.'s Cement Show at Chicago February 18 to 24, to be held at the Chicago Coliseum.

RECLAMATION OF LANDS.

One hundred thousand acres of immensely fertile but semi-arid land at the very gates of Denver, Colo., are to be transformed into productive farms and market gardens with the water to be stored behind the Standley dam, the contract for completing which has been let by the Denver Reservoir Irrigation Company to the Kennefick-Quigley Company of Kansas City.

This is the first real step toward the irrigation of hundreds of thousands of acres of arid land north of Denver, and within but a few miles of the city limits.

The Standley dam is in Jefferson county, nine miles from the city hall and five miles from the city limits. It is to be built across a natural basin extending eastward from the foothills, and when completed will create a reservoir which will be 136 feet deep at its deepest point, and will hold 100,000-acre feet of water or enough to cover 100,000 acres of land one foot deep.

Considerable preliminary work toward building the dam has already been done, but the contract let recently includes practically all the real construction work and provides for the completion of $1,250,000, and will be but little more than a beginning of the immense amount of work to be done in completing the big irrigation plan, the entire cost of which will be about $4,000,000.

Among a number of others are two Denver firms, the C. T. Carnahan Manufacturing Company and the Denver Rock Drill and Machine Company, which have sent representatives to Johannesburg, South Africa, to enter an international mine drill contest, the first prize of which will be $20,000. This is the largest prize ever offered in such a contest and in addition to the purse the winner's drill will have prestige throughout the world.

The rules of the contest provide that two samples of each style of drill entered shall be operated day and night without stop for a period of six months, beginning January 1, 1909. Speed, durability and other general points will be the features of the contest.

The Union Pacific has an extensive amount of work in progress in the vicinity of Tacoma, Wash., and will have additional work under way in a short time. Dibble & Hawthorne are working on the construction of the Oregon & Washington between Tacoma and Portland, a distance of 150 miles. Up to this time they have completed 15 miles and are now working on the yards at So. Tacoma. They are doing this work on the percentage basis and have been limited to the amount that they are allowed to do. The material consists of loose and cement gravel and the placing of concrete and steel. It will require the removal of 700,000 cubic yards of material and the laying of 75 miles of track in order to complete the yards. Bids were received till noon November 30th for the construction of a 7,800-foot tunnel in Tacoma. This work is in charge of H. F. Baldwin, chief engineer, Burk Blk., Seattle, Wash. Mr. Baldwin has been in the east conferring with Mr. J. R. Farrell regarding this work, and they decided that the tunnel should be put through at once. Eleven contractors were asked to put in a bid, among whom were Nelson & Bennett and Dibble & Hawthorne Company, both of Tacoma, and others from Seattle, San Francisco and Portland.

F. C. Stevens, State Superintendent of Public Works, Albany, N. Y., awarded the contract to the United Engineering and Contracting Company, 32 E. 33rd street, New York, at $2,166,298 for the improvement of the Erie Canal, a distance of five miles. Butler Bros. Hoff Company, 1170 Broadway, New York, were awarded the contract at $281,330 for forming embankments at the Iron Creek Crossing of the canal. The Kinser Construction Company, Chicago and Fort Edward, N. Y., were awarded the contract at $1,212,-833 for the construction of the canal from Fox Ridge to Galen. Crowell-Sherman Co., of Cleveland were awarded the contract at $1,262,638 for the construction of the canal 15 miles westward. Shanley-Morrissey, Inc., 527 Fifth Ave., New York were awarded the contract at $1,018,323 for the construction in the Hudson river of Lock No. 3.

Boston & Eastern Electric R. R. Co., which proposes a 7,500-ft. tunnel under Boston harbor, a subway terminal at Post-office square, Boston, Mass., to apply to the incoming legislature for permission to build its tunnel. John H. Bickford, of 110 State St., Boston, Mass., engineer for the company, states it will take about 2½ years to build the Boston-Beverly line; that it will cost about $11,000,000; that it will be 22 miles long and will serve a population of 260,000 people outside of Boston.

The Chicago Cement Show will be held at the Coliseum, Chicago, February 18 to 24.

The American Engineering Co., Chas. N. Wilson, president, Indianapolis, Ind., has been awarded the contract for financing, surveying and superintending the construction of the Des Moines, Sioux City Interurban Ry. The proposed line is about 196 miles long and will be a part of the triangular system that is being constructed and connect Des Moines, Ia., Sioux City, Ia., Omaha, Neb., and Council Bluffs, Ia.

The Charlotte Constructing Co., with a capital of $50,000, and head offices at Charlotte, N. C., has been organized by S. B. Sargent, Frank W. Comb, W. H. Grose and O. V. Branson.

Bids were opened Nov. 27 at the offices of the Oregon & Washington Ry. Co., in Seattle, Wash., for the construction of the big tunnel on the Columbia River extension to Tacoma. Rydstrom & Hudson, Tacoma, Wash., are reported to have been the lowest bidders for the contract, which will involve the expenditure of about $1,-250,000.

Don't miss the Chicago Cement Show at the Coliseum February 18 to 24.

The Nelson Valve Company of Philadelphia, have recently established two branch offices in the Middle West, to keep pace with their rapidly expanding business, one of them in Detroit, in the Penobscot Building, the other in Cleveland in the Perry Payne Building, Mr. John M. Bulkley, has been appointed Sales Manager for the territory of Ohio and Michigan.

Bids were received Dec. 4 by the Water Commissioners of Springfield, Mass., for constructing the Borden Brook dam and reservoir. The Cement Paving & Construction Co., 1 Montgomery St., Jersey City, N. J., at $146,450, was low bidder. The next low bidder was Robert K. Everett, Tarrytown, N. Y., at $148,300. The work will include 10,000 cu. yds. earth excavation, 4,000 cu. yds. rock excavation, 35,000 cu. yds. rolled embankment, 3,000 cu. yds. gravel fill, 3,000 cu. yds. concrete masonry, 8,000 sq. yds. slope paving, 3,000 lin. ft. stone wall, placing c-i. pipe, gates, etc., gate-house and appurtenances, 1,500 lin. ft. macadam roadway, 17,000 lin. ft. common roadway, clearing reservoir site.

Come to the Cement Products Exhibition Co.'s Cement Show at Chicago February 18 to 24, to be held at the Chicago Coliseum.

EXTENSIVE IMPROVEMENTS.

The Chicago Portland Cement Company Has Recently Made Alterations and Additions Greatly Augmenting Its Capacity.

The Chicago Portland Cement Company, of 108 La Salle street, Chicago, has made extensive alterations and improvements at its plant at Oglesby, near La Salle, Ill. This company only manufactures one brand of cement, known everywhere as Chicago AA, and it is considered one of the standard brands and too well known to need any introduction at this time. During the past year it has considerably enlarged its plant and has almost doubled its capacity.

The buildings are all constructed of structural steel, with concrete hollow block walls and tile roof. The boiler house has been doubled in size and is now 52x125 feet and contains six 280-horsepower boilers with automatic gates. The building is designed for eight and the other two will be installed shortly. Boiler feed pumps of large size have been installed in duplicate and a water purifying system to prevent scale in the boilers. The ashes from the chain grates fall into concrete pockets by gravity. An ash car underneath gathers the ashes and is lifted by hoist attached to a trolley, both operated electrically, carrying the car out over the dump, automatically dumping and returning under perfect control, through electrical switches manipulated by the ash man, who remains in the boiler house. The old boiler room contains six of the same type boilers, with complete pump equipment.

The new engine room, which is 58x62, is designed for three 1,500-horsepower turbine steam engines, with generators attached; surface condensers, vacuum pumping engines, engine driven exciter, moter driven exciter, an elaborate switchboard, overhead electric traveler, drain pumps, etc. In fact, an up-to-date power house, with all of the latest improvements. Circulating water for the condensers is cooled in cooling towers.

The old engine room contains two 1,000-horsepower, cross-compound engines of Corliss types.

A large part of the power from the old power plant was electrically transmitted. All of the new machinery is electrically driven, even the drilling in the quarry is done by electrically driven drills.

The cold storage house is 59x148 and is built over a concrete pocket holding 600 tons of coal. Illinois coal screenings are used, coming from nearby mines in bottom dumping cars. One man empties the entire coal requirements of the factory. Conveyors and elevators take the coal from the storage to a screen room over the boiler supply bin. All coal is screened here, the coarse coal only going to the boilers in a trolley car, which keeps the grates supplied. The fine coal is conveyed to the coal grinding room, dried by improved dryers and ground by two rollers and three tube mills, which were manufactured by the F. L. Smidth & Co., New York City.

The new grinding department contains nine Ball mills, two comminuters and twelve tube mills, and is the older part of the plant, combining the original raw grinding room and the original clinker grinding or finishing mill, both being so arranged as to make a harmonious arrangement or combination into one department. The rock dryer department is 86x106.

The kiln room is 163x182 and is designed for eight rotary kilns, 7 feet by 136 feet (six kilns now operating). Clinker from kilns conveyed by pivoted bucket carrier direct from kilns to rotary boilers, 6 feet by 100 feet, or to outdoor storage, the carrier traveling over a structural steel bridge, 160 feet long, at 60 feet elevation; the same carrier passing through a tunnel under the clinker storage returns cooled clinkers to conveyors inside of the buildings and to rollers that crush the clinker for feeding the Kent mills.

The mill building is 54x70 and is designed for ten mills (seven erected), placed on second floor, with a screen under each mill, delivering directly into conveyors by gravity.

The new finishing mill is 108 by 122 and is designed for sixteen tube mills, 5½ feet by 22 feet (ten erected), and provided with a steel storage bin for the feed, having a capacity of 5,000 barrels.

Stock house No. 1-B is 70x182 and is an extension of No. 1-A, and the combined length is 490 feet, located on switch tracks connecting with the Illinois Central railroad. Stock house No. 2-A is 70x208 and is located on a level 40 feet above No. 1 stock house and has switch tracks from the C., M. & St. P. railroad. Both No. 1-B and No. 2-A stock houses are of reinforced concrete, each provided with large sacking rooms containing a unique and absolutely new system of apparatus for sacking cement economically and rapidly. The sacking facilities have a capacity of 9,000 barrels of cement daily, which can be readily shipped from stock during the rush seasons. There is also a bag storage house 40 by 72.

A feature peculiar to this mill is the aerial tramway, conveying rock and clay from the quarry to the mill.

The aerial wire rope tramway in operation at this plant was furnished by the A. Leschen & Sons Rope Company of St. Louis, Mo. The system is known as the Leschen Company's Patent Automatic Aerial Wire Rope Tramway, which is of that class

Improved Plant of the Chicago Portland Cement Company, Oglesby, Ill.

F. L. Smidth & Co., New York City, furnished the Ball Mills, Tube Mills and Kominuters. A. Leschen & Sons Rope Company, St. Louis, Mo., installed the Aerial Wire Rope Tramways.

known as the Double Rope type of tramway. This tramway is used for transporting the crushed rock and shale from a point near their quarry up to the mill, a distance of approximately 1,300 feet.

The tramway was originally built in the spring of 1899, but subsequently it was re-equipped to meet the increasing requirements of the Chicago Portland Cement Company, so that today it is capable of transporting the large amount of 90 tons of rock and shale per hour.

The tramway within its length has a rise of approximately 177 feet, so that the material is carried upgrade for the entire distance, which is accomplished by means of power gearing connected to the terminal shaft in the mill building.

There are six supporting towers, every one of which is of steel, and most of them are over 60 feet in height, one in particular, reaching the height of 80 feet. These towers support the track cables on which the buckets travel, and also hold up the traction or running rope by means of sheave wheels placed in the head of the tower.

The track rope on which the loaded buckets travel is 1½″ in diameter and of the Leschen Company's Patent Flattened Strand construction and of their Hercules quality. The track cable on which the empty buckets return is 1¼″ in diameter, also of the Patent Flattened Strand construction, and of the Crucible Steel quality. The rope used for propelling the buckets, namely the traction rope, is ⅞″ in diameter, of the Patent Flattened Strand construction, Special Steel quality.

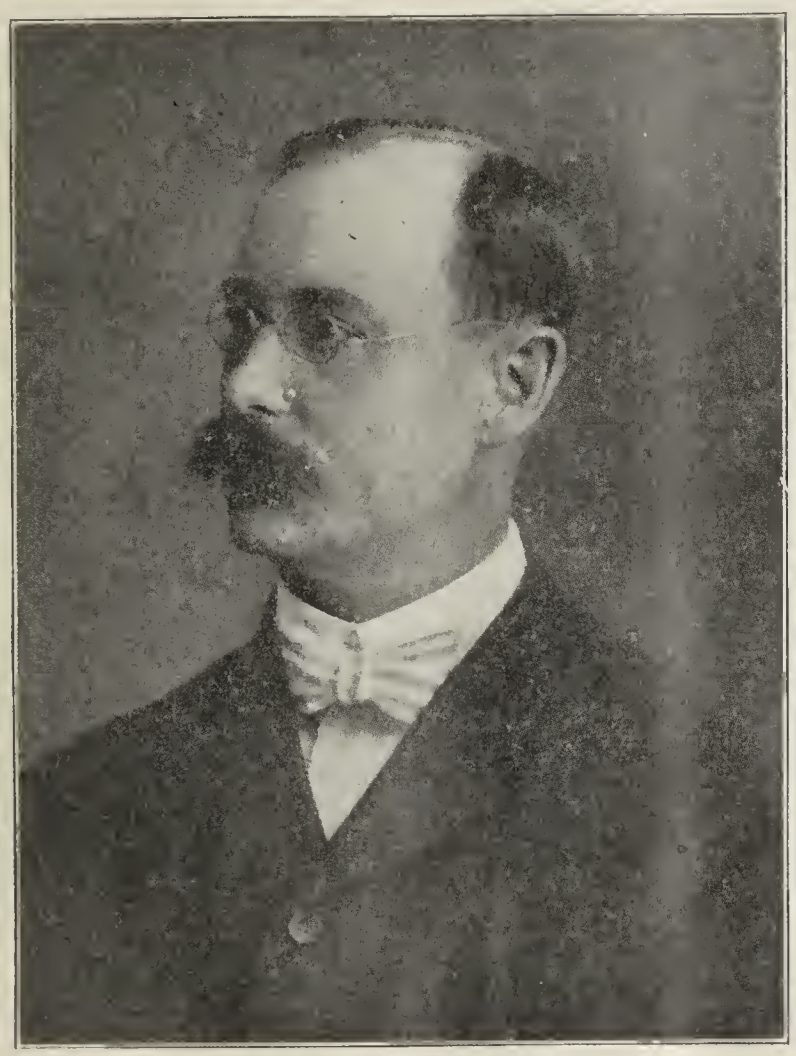
The track ropes are anchored to beams in the mill at the upper end, while at the loading point they are attached to turnbuckle connections, thus maintaining proper tension in the cables.

The buckets used for carrying the material hold 1,000 pounds each and are closely spaced along the line. Each bucket is fitted with steel wheels for running on the track cable, each wheel being provided with brass bushing and oil cup. The buckets are attached to the frame by trunnions so as to swing freely when discharging. At the bottom of the bucket is a pin with sheave arrangement, the latter running on a curved bar at the discharge terminal in such a manner that when the bucket travels around the terminal, and without stopping, the material is automatically discharged into a conveyor scheme for carrying the material within the building to the proper places.

On the traction cable at equal spaces are positively fastened button head clips to which the carriers are automatically attached and detached at the loading terminal. These clips make it impossible for a bucket to slip while traveling, which is a valuable feature and means an avoidance of runaways. These clips are so arranged that they can be easily attached or detached in connection with the traction rope, as may be found necessary.

The Chicago Portland Cement Co. have an immense concrete bin at the loading terminal, into which the crushed rock and shale is dumped as it is brought from the quarry. When a tramway bucket enters the loading terminal it is automatically detached from the traction rope, and then stops in front of the chute of the bin mentioned. An operator then loads the bucket through the bin chute, and allows the bucket to remain stationary until the next clip comes along, which has just been detached from the following bucket. This clip first accelerates the bucket to the speed of travel of the tramway, when the clip becomes engaged to the bucket and remains engaged until it returns ready for the next load.

From the description given of the discharging of the bucket at the mill, and the arrangement of the loading terminal it will readily be seen that the tramway is automatic in its operation, with the result of exceedingly small cost in transporting the material.



Norman D. Fraser,

President, Chicago Portland Cement Co.

OBITUARY.

Henry Wallace Caldwell, President of the H. W. Caldwell & Son Co., of Chicago, died at Redlands, California, on December 22nd, 1908. The deceased was the founder of the business. He was an honest, upright and conscientious business man and possessed more than ordinary ability as a mechanical engineer, and built up a great manufacturing industry in elevating and conveying machinery.

The Superior Portland Cement Co. office at Baker City, Skagit Co., Washington, made its first shipment of cement to Tacoma. The Stebbins, Cemmes, Spinmury Co., incorporated, has been found to act as selling agents for the company with offices at 1011 A. Street Tacoma.

Glen C. Hyatt, of Bellingham, Wash., reports that he had practically completed arrangement for building of a cement near Kendale, by interesting the Balfour-Guthrie people, the plant will be located on the Bellingham Bay & Bullish Columbia Ry. Mr. Hyatt is Vice President of the Bellingham Bay Improvement Co. and its General Manager.

Don't miss the Chicago Cement Show at the Coliseum February 18 to 24.

THE BIG ROOSEVELT DAM IN ARIZONA.

The most notable of the great irrigation projects undertaken by the government for conveying water to the arid lands of the West and the Southwest is the Roosevelt or Salt River project on account of the great dam which is being built and the elaborate works which are being completed in connection with it. The dam will form a storage basin holding sufficient water to flood 1,300,000 acres to the average depth of one foot. This quantity is much larger than the volume held in storage by the greatest Nile reservoir. The supply will be secured from the Verde and the Salt River, which drain a watershed of 6,260 square miles. The average yearly rainfall over this drainage basin is not over 20 inches. The annual rainfall upon the territory to be irrigated ranges from 3 to 10 inches, and the rapid evaporation of moisture is indicated by the fact that the temperature in summer ranges as high as 120°, although the elevation varies from 1,000′ to 1,300′ altitude. The dam will impound sufficient water to irrigate fully 270,000 acres of soil. This soil is known to be fertile when water in sufficient quantities is applied, the Department of Agriculture having tested a few experimental tracts, with the result that the crops have been remarkable for their quality and yield.

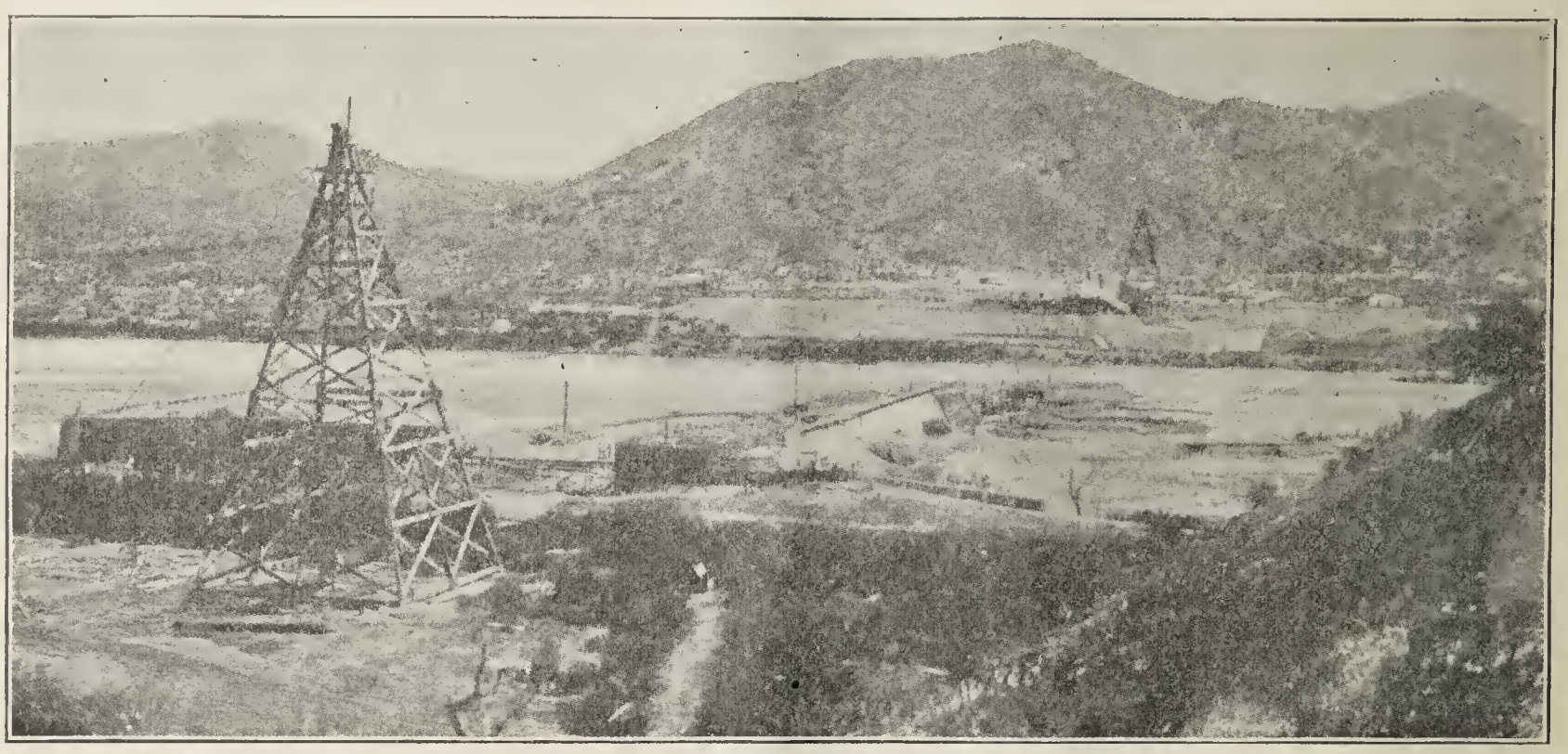
It is an interesting fact that if it were not for concrete this undertaking could not be accomplished, for the material referred to is a most important element, since such an enormous quantity of it is used for various purposes, so much so that the government manufactures its own cement and mixes its own concrete. Most of the raw material for the ingredients is obtained in the vicinity of the work.

A feature of the undertaking is the power canal. Water power or electric current has heretofore been secured from dams intended for irrigating purposes by utilizing the waste water. Such power, however. is available only when the flow of water into a reservoir is more than sufficient to fill it. The power at Roosevelt is obtained independently of the irrigating scheme, the canal being separate from the reservoir and one of the first works completed. The head of water secured by means of the canal actuates water-wheels connected to electric generators. From the power station extends a transmission line conveying current to the plant for the manufacture of cement, the stone-crushing plant, for lighting, operating the aerial railway and for other purposes. Under a head of 250 feet, hydraulic jets with nozzles of 11″ have been used to wash away the loose formation and accumulation of sump above the bedrock upon which the dam proper is being built, and have greatly facilitated progress. Much of the gravel thus secured has been utilized for construction material. To remove the gravel, elevators have been placed in service.

This power canal, which extends a distance of 20 miles, including 10,000 feet of tunnels through the mountains, is lined entirely with home-made concrete and in some places is carried over gulches and valleys on massive spans of the same material. The necessity for this power canal is shown by the work it performs, and though the building of the canal and auxiliary work represents a cost of nearly one million dollars, it would have been impossible to construct the dam proper without its aid, while the power it affords is such that it has greatly reduced the cost of transferring materials and performing other labor. It develops over 4,000 electrical horse-power and all of it is used for operating machinery and for illumination.

These figures will give an idea of the immense quantity of concrete needed for the building of the dam proper outside of the conduits, gates and other words. Consequently arrangements were made for its production on a very large scale.

In estimating the cost of building the Roosevelt dam it became necessary to obtain from manufacturers prices on the delivery of about 200,000 barrels of cement at Globe, Ariz., then the nearest railroad point. Early bids and estimates from manufacturers show that the cement delivered would cost approximately $9 a barrel. At that time it seemed as though there would be no chance of having this price materially reduced. A careful examination of the country adjacent to the dam site showed a large deposit of high-grade limestone. Preliminary estimates of the cost of a cement mill with an output sufficient to meet the needs of the contractor



The Roosevelt Dam.

The Government built their own cement mill on the site for furnishing the necessary cement in its construction. Allis-Chalmers Company, Milwaukee, Wis., furnished all the cement making machinery. The Link Belt Company installed the Clinker Elevator.

during the construction of the dam, and of the cost of manufacturing, showed a large saving compared with the cost of cement purchased and hauled to the dam. Accordingly, specifications were drawn and bids asked for building a cement mill near the present town of Roosevelt.

As some manufacturers claimed that they were able to furnish cement at a much lower price than the United States was able to manufacture it, bids were asked for the delivery of 150,000 barrels of cement at the dam site. The lowest price obtained was $4.98 a barrel. As this price was much higher than the cost of manufacturing, plus the cost of the mill, as estimated by the government engineers, the bid was rejected. This bid was based on a wagon-freight rate of $8 per ton from Globe to the dam site, a rate 02 per ton, or approximately 40 cents per barrel, less than the prevailing one. Cement at that time was selling at the works for $1.10 a barrel. Today at the same points it is selling for from $2 to $2.10 a barrel. The entire cost of building the cement mill was $218,380.57, which includes all cost of excavation, foundations, building, machinery, erection, and every charge usually made under the heading of betterment of plant.

The mill, which is equipped entirely by the Allis-Chalmers Company of Milwaukee, with the most modern machinery for grinding and preparing cement, has the capacity of 10,000 barrels a month, but practically all of this output has been needed as operations have progressed, owing to the many uses to which concrete or cement has been put. As a result of the decision of the government to erect this plant, the cost of the material has been reduced to such a low price that the estimate of the cost of the works has been considerably reduced. The site of the mill was selected with the view of delivering cement to concrete mixers stationed at various points along the site of the dam. All of it is conveyed from the mill to the mixers by a patent aerial wire rope tramway.

The aerial wire rope tramway, built by J. M. O'Rourke & Company, Roosevelt, Ariz., the contractors for the Roosevelt Dam, was furnished by the A. Leschen & Sons Rope Company, St. Louis, Mo. This tramway is known as the Leschen Co.'s Patent Friction Grip system, which is a double rope tramway in which stationary track ropes are used for the carriers to travel over, and an endless traction rope for propelling them.

The total length of this tramway is approximately 1,700 feet, in which the discharge terminal is about 50 feet lower than the loading point.

The tramway was built in 1906 and has a carrying capacity of 20 tons per hour of cement and sand, used in the making of concrete for the construction of the dam.

The cement is taken in bulk from the bins of the government cement plant, located at the loading terminal, while the sand is loaded into the carriers at an intermediate point, about 650 feet from the government cement mill. This sand is obtained from the surrounding hills in the shape of rock, which is crushed and deposited in a bin at the intermediate station. All of the sand and cement is discharged at the lower terminal into separate bins, from which the material is drawn off and used in the making of concrete, as above indicated.

The track ropes are supported by Intermediate Towers. The traction rope is also supported on these towers by means of sheave wheels. Both track ropes are of the Leschen Co.'s Patent Flattened Strand construction and of crucible cast steel quality. Both of these ropes are anchored at one terminal and attached to a tension arrangement at the opposite end. The traction rope, to which the buckets are gripped is 5/8" diameter, also of the Patent Flattened Strand construction and of crucible steel quality.

The buckets used for carrying this material are 10 cu. ft. in size and are fitted with steel sheaves which run on the track cables. Each sheave is provided with brass bushings and malleable oil cup. Within the body of the frame supporting the bucket is located a Patent Friction or Compression Grip, which by means of a lever attaches the buckets to the line. At each terminal and at the intermediate loading point, an attaching and detaching frame is used which operates in conjunction with the grip lever, so that the engaging and disengaging is practically automatic.

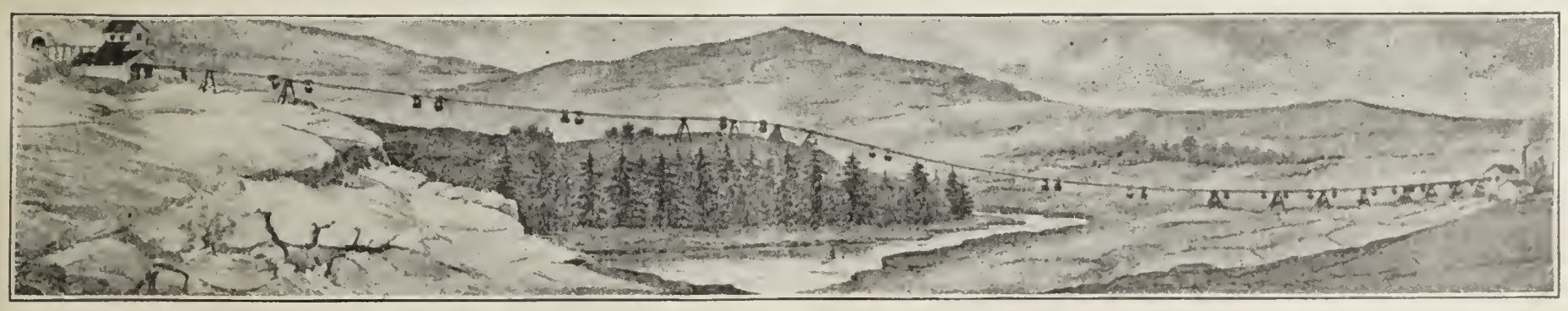
The terminal stations and intermediate loading point are provided with ample switches and rail, whereby the carriers may be readily handled as may be desired.

The necessary power to operate the tramway is applied by means of a Bevel Gear located at the discharge terminal.

This tramway is very efficient in its operation and does the work required in an economical manner and at a low cost per ton carried.

In addition to the main dam, as it may be called, concrete is being used in very large quantities in the erection of a diversion dam that is being constructed at a point where the water of the rivers are restrained. This barrier is used merely to raise the water in the rivers to a height of about 15 feet, but is so massive that it will contain over 10,000 cubic yards of concrete alone. It is 1,300′ in length. This diversion dam is located about 30 miles from the main dam, but is a portion of the Roosevelt project as a whole.

Work on the construction of the dam proper has been in progress only since September 20, 1906, owing to the immense amount of labor required in making the excavations in bedrock. When it is remembered that the height of the dam above the rock is 284′, the length at the bottom 235′, and the length at the top 1,080′, the time and labor required in preparing the site for the wall do not seem excessive. The work is what is technically known as a masonry arch dam with a gravity section rising from the foundation. It will range in thickness from nearly 175′ at the bottom to 16′ at the top—sufficient to provide a highway for vehicles. As



View of the patent Aerial Wire Rope Tramway installed at the great Roosevelt Dam in Arizona for conveying cement from the cement mill to the concrete mixers. This tramway is over 1,700 feet long and is manufactured by A. Leschen & Sons Rope Co., St. Louis, Mo.

soon as the block of stone are quarried they are carried to the site and placed in position by boom derricks, while the Leschen aerial tramway conveys the cement in which they are set. An enormous quantity of rock, set in concrete, is required for filling in behind the face, and boulders as large as can be handled are used. Nearly 400,000 cubic yards of masonry will have been placed in position when the dam is completed, and the reservoir which it will create will form a lake 25½ square miles in area. As soon as the dam is finished the cement mill and other construction plants will be stripped of all machinery which can be profitably removed, and the buildings abandoned, as they will be many feet under water when the reservoir fills.

The accompanying illustration gives an idea of the great dimensions of the work, and especially the important part played by concrete. While this material has been invaluable in connection with various irrigation works being completed in the West, the construction at Roosevelt is perhaps the best example of its importance.

Come to the Cement Products Exhibition Co.'s Cement Show at Chicago February 18 to 24, to be held at the Chicago Coliseum.

F. & M. Sloss of Birmingham, Ala., are reported to have sold a large tract of land, conveying coal, shale and limestone on the line of the Louisville & Nashville Ry., in the vicinity of Birmingham to a strong Pennsylvania corporation which is to erect a Portland cement plant on the land purchased.

The Sandusky Portland Cement Co., of Sandusky, O., are supplying their White Portland Cement for use in the following important contracts:

For exterior cement stucco on Davis-Schonwasser Bldg., San Francisco, Cal.

In Mausoleum being erected at Swanton.

Masonic Temple Bldg., St. Louis, Mo.

For lining and finishing swimming pool at Sanford Public Bath, St. Louis, Mo.

In work on the Capitol Bldg., at Santa Fe, N. M.

On the Seaview Hospital, Staten Island, N. Y.

They are also furnishing their Waterproof Compound in the following important work:

Presbyterian Hospital, Chicago, Ill.

New Washington Hotel, Seattle, in basement floor work.

On John Jacob Astor Estate, Rheinbeck, N. Y.

New City Insane Asylum, St. Louis, Mo.

In City Reservoir construction at Oil City, Pa.

THE MANUFACTURE OF CONCRETE DRAIN TILE.

A Coming Industry.

One shining example of remarkable success in the line of manufactured commodities of concrete is the flourishing drain tile business that has been developed principally in the last two or three years in those sections of the West where the surplus oil waters must be removed before anything approaching maximum crop production can be attained. Already the field of operation is widening in this line to the delta lands of the South, which, when reclaimed, will make one of the most fertile regions of the world. The climatic conditions make possible almost priceless crops of fruits and vegetables, and they lie close enough to market to make immediate results tangible the first year after the improvement of drainage is provided for. In California, far beyond the reach of present transportation facilities for clay drain tile to reach, they are awakening to the opportunity presented by the adoption of concrete drain tile as the only means to successfully reclaim countless square miles of what is now little better than waste land to the agriculturist.

The drain tile business, starting in the Middle West to meet the needs of the farmers already engaged in the cultivation of valuable land, is merely in its infancy, for the work that lies before the concrete drain tile industry from now on into the future amounts to the stupendous undertaking of reclaiming an area of farming land equal to that part already under cultivation. Not this generation or even the next will see any appreciable diminution of the field for operations. Whole sections as yet unknown to the agriculturist will be made to blossom and bring forth fruit abundantly, and the day is at hand when waste lands will yield fortunes to tile manufacturers with the capital to improve cheap real estate by simply putting in the tile to give sufficient drainage.

Speculative capital is looking in this direction at the present time, because it is close to Mother Earth and too simple a route to big profits to go unseen. It is clearly better, saner and safer than any mining project that has been successfully exploited in recent years, and better still, it is a proposition that will appeal to the farmers, who are rapidly becoming the holders of the surplus or speculative wealth of the land. At the same time it is a proposition which can be capitalized, controlled and operated by the farmers themselves and an intimate knowledge of every step of the proceedings, thereby assuring intelligent and profitable administration. In this way the concrete tile offers a suggestion for the farmer by using the practical knowledge obtained in his own farming business to keep his investments in his own hands.

This is a pointer to the legitimate promoter—the man who knows how to make the tile right—to get busy in the direction of big things in the concrete tile industry, even though it may mean large activity a long ways from home. The drain tile manufacturers as a rule have all the business they can take on for this season without any extraordinary effort on their part, and nearly every man is working his think tank to figure out a longer day, or, failing in that, an increase of capacity by additional machinery.

A correspondent visited some of the busy Western shops where drain tile manufacture is a specialty, and he gives the following expert observations:

"About the first of May I happened to notice the extensive plant of a tile manufacturer in an Iowa town. They had just set up and started into operation the second tile machine to increase the capacity of their plant. It was installed by the Cement Tile Machinery Company of Waterloo, Iowa. The first machine was installed about eighteen months ago, and has been running continuously since first put into operation, and the proprietor stated that he had not a tile in stock that was old enough to send out, as it is his practice never to deliver any tile that are less than thirty days old.

"For the purpose of introducing concrete drain tile in the local market he took a county contract which required large quantities of tile, ranging in size from 6 to 24 inches in diameter. All the tile larger than 12 inches in diameter were made in hand molds, but the smaller sizes were all machine made. This county contract was started two years ago this coming fall, and quantities of the tile were delivered then upon practically the full length of the line, but the work was delayed for the purpose of completing the main ditch into which the line discharges. The tile delivered during the latter part of 1906 and the early part of 1907 lay unprotected from the weather along the line until they were put into the trench, some of which had been done comparatively recently. In fact, I saw nearly a mile of tile stretched out through the swamp

above ground, most of which was delivered in October and November, 1906. Some of these tile were entirely submerged, while others were partially under water, and still others were entirely high and dry. The tile had evidently been frozen repeatedly in the position in which I saw them, but when examined they were found to be in perfect condition. The number of broken tile along this line was remarkably small. I noticed some 15-inch tile two feet in length which were about two years old being placed in the trench which at that point was about 10 feet deep. The treatment received by this concrete tile which had lain exposed for two winters, and subjected to the natural freezing and thawing of that period certainly proves their superiority to drain tile made of clay in this particular. No clay tile other than a perfectly vitrified one could resist disintegration under such conditions. In fact, it is well known to those who are interested in land drainage that ordinary drain tile of clay are badly disintegrated by the action of frost, and the outlets of drains using them are constantly changing, due to the breaking down of the exposed tile.

"My interests growing in the matter, I learned of several farmers in the immediate neighborhood who had made use of quantities of the product of this plant in draining their lands and I examined some or the concrete tile drains which have been in almost two years. I observed the outlet on a farm drain system and found the 8-inch tile at this point in first-class condition. The first fifty or sixty feet of this line was covered with only earth enough to protect it against stock, and therefore exposed to the extremes of freezing and thawing for two winters. After finding the tile in that outlet in perfect condition I went to the head of the ditch and exposed the tile which were at this point covered by about four feet of earth. The tile here was also found to be in perfect condition. I examined the tile on a 4-inch lateral line and here found this size also in first-class condition, and the farmer, who is quite an enthusiast over the perfection of his drainage system, remarked that these were harder than when they were put in, as they were taken from the plant when only two weeks old. He stated that there was very little loss in the handling of concrete tile in the operation of laying it in the ditch and hauling it to his farm, and further that his drains were giving perfect satisfaction.

"I will say that this statement was verified by the splendid flow witnessed at the outlet of the system. Together we crossed over to an adjoining farm and visited the outlets of several clay tile drains. My farmer friend and companion advised that these drains had been in over a year longer than his; that is to say they had passed three winters. I believe I am safe in saying that there was not as much water being discharged from five separate lines as from the one just cited, although the total area drained was very much larger. The outlets of three of these clay tile lines were constructed of hard glazed tile, while the other two, of soft clay, showed a very marked tendency to be disintegrated for about 10 feet, the broken down tile having been shoveled out, and an open drain was being used from the present end of the tile to the lake into which it emptied.

"At another town I took occasion to inquire as to the developments and progress of the drain tile branch of their operations, and one of the proprietors informed me that they had never been able to keep up with their orders at that place for concrete drain tile and blocks. They have been in business for a number of years and have a splendidly equipped factory, steam heated in winter and electric lighted. The plant is run the year around, and the proprietor is a great believer in the future of cement products, in which they have built up a very satisfactory and profitable business.

"There is no question in my mind after these observations, which were conducted as carefully as could be, but that concrete tile drains the soil more thoroughly and rapidly than do clay tile. I long ago observed that most clay tile, though they are certainly affected by frost, are not sufficient porous to permit the passage of water freely. Drainage therefore is entirely through the joints. Concrete tile of the same length have equal drainage through the joints, plus the drainage through the shell.

"The last manufacturer of tile mentioned above told me of one farmer who placed two lateral lines in the same field, draining about the same area, one using clay tile and the other concrete tile. This farmer reported that he was able to raise a crop last year from his concrete tile, while the crop over the clay tile was destroyed owing to the failure of the latter to carry thewa ter off before the young crop was killed. Such testimony, I take it, is the best practical endorsement that could be secured for this thriving branch of concrete industry."

Those who desire information, literature, etc., regarding machines for the manufacture of concrete drain- tile should write the Cement Tile Machinery Company of Waterloo, Iowa.

TO INCREASE CEMENT OUTPUT.

Announcement of the addition of machinery and equipment which will increase the total investment to more than $2,000,000 is made by the Marquette Cement Manufacturing Company of Chicago. The works of the concern are at La Salle, Ill.

The improvements will increase the output 50 per cent over that of last year, bringing the total to 6,000 barrels of Portland cement daily. The company's works already are the largest in Illinois. They were started twelve years ago with an output of 500 barrels a day.

The concern is controlled and directed by William and Theodore Dickinson of Chicago, pioneers in the cement industry. The increased output is provided for because of the anticipation of an increased consumption of cement, everything indicating a return of prosperity to this branch of the building trade, as cement now is being used largely in every building project.—From Chicago Record Herald, Jan. 6, 1909.

The Glens Falls Portland Cement Co., has purchased four dwelling houses in the vicinity of its plant, the owner of which had applied for an injunction to restrain the cement company from operating its plant, on account of the cement dust and smoke produced by the plant settling on the property.

The Hidalgo Cement Co., of San Nicholas, Hidalgo, State of Nueva Leon, Old Mexico, is producing 450 barrels of cement per day. F. F. Neggil, Gen. Manager and J. J. Gallagher, General Salesman for the Company, both men were formerly from Texas.

PRIZES FOR CEMENT SHOW EXHIBITORS.

The Northwestern Cement Products Association, will award prizes to exhibitors at its next annual exhibition to be held at Minneapolis on March 2nd, 3rd and 4th. These prizes are contributed by the St. Paul Builders Exchange, the Minneapolis Builders Exchange and the St. Paul Commercial Club. A large attendance is looked for by the managers of the Association.

THE CANADIAN PORTLAND CEMENT COMPANY'S PORT COLBORNE PLANT.

Built by the F. L. Smidth & Co.

One of the finest cement mills in Canada has just been completed at Port Colborne, Ont., for the Canadian Portland Cement Co., whose main offices are at Toronto. This modern up-to-date mill was designed by the F. L. Smidth & Co., New York City, and is situated on the Buffalo and Goderich division of the G. T. R., one mile west of Port Colborne and one of the few limestone propositions in Canada.

The limestone deposits of this company comprise an area of 135 acres, having an average depth of 21 feet. The rock, a crystalline limestone, is covered by about five inches of soil only. A 50 horse-power portable boiler supplies steam for two steam-driven rock drills and an air-compressor. This latter is used to operate a pneumatic "plugger," employed to break the larger masses separated by the blasting. At present, the hoisting to cars is done by skips and a locomotive crane, but the management contemplate the early installation of a steam shovel. The quarry is distant from the plant about 2,000 feet. To exhaust this immense deposite at the present output of 300 tons per day would require something like 120 years.

About a quarter of a mile farther west are situated the clay beds, some ninety acres in extent. The stripping here runs for six inches to two feet, and is removed by the locomotive crane which excavates the clay. This crane, supplied by the Browning Engineering Co., is furnished with a Hayward orange-peel bucket of one yard capacity, can lift and lay its own track, and on a steel railway can travel four miles per hour. The depth of clay is variable, from ten to sixteen feet and beneath it and above the limestone bed-rock is usually found one foot of hard-pan. Both clay and limestone are loaded on dump cars and hauled to the works over a standard gauge steam road, constructed, owned and operated by the company.

The limestone is reduced to a two-inch ring in two crushers, each of 25 tons capacity per hour. From here it passes to and through a 50-ft. x 6-ft. cylindrical dryer, and thence to the raw grinding mill. The clay, containing, of course, more moisture, is dumped in a storage shed, beneath which a tunnel, with axis corresponding to that of the shed, has been constructed. An endless belt in this tunnel conveys the clay to a second rotary dryer similar in its dimensions to that through which the limestone passes. These rotary dryers obtain their heat chiefly from the waste gases from the rotary kilns, which are housed in the same building. This is supplemented when required by burning natural gas, obtained from wells in the locality. Further reduction of the dry clay is accomplished in a Fuller mill. It is then deposited in bins over the automatic scales, by which the correct proportioning of the raw materials is performed. The limestone is ground in kominuters and is similarly deposited.

From the two ingredients as they come to this mill continuous samples are automatically taken. The chief chemist makes from these the determinations which enable him to set his scales to discharge the two materials in proper proportions. If the samples change at all in composition, the scales are adjusted to meet the new conditions. To these weighing scales the supply comes from above. When the necessary weights of the two ingredients have been nearly but not quite reached, a trip lever reduces the speed of both feeds proportionately, and the final quantities making up the total amounts drop into their receptacles slowly until the precise weights are obtained. Another ingenious device, which operates only when both receptacles contain their necessary quantities, serves to discharge both simultaneously, the materials being carried away together. This mixture now correctly proportioned, passes to tube mills, and is further ground so that 95 per cent. will pass a No. 100 sieve. The storage bins above the kilns receive this finely reduced product. The rotary kilns are 150 ft. by 8 ft. 6 in., and as is usual in such plants, have a speed which is controlled by the operator. The fuel is ground coal and natural gas, the former being blown in by air blast. The clinker, as it drops white hot from the kiln, is transported by a continuous McCaslin bucket conveyor to the rotary cooler, 50 ft. long and 6 ft. in diameter. To the inner surface of this cooler are riveted steel channels which, by alternately lifting and spilling the hot clinker, expose it the better to the current of air passing through. This current, created in cool weather by natural draft only, is quite capable of cooling the clinker to a grinding temperature. In warm weather, however, a suction fan is sometimes employed. The cooled clinker is conveyed to the cement grinding mill, or, if not required immediately, to the clinker storage shed.

The Canadian Portland Cement Co.'s New Mill.

The coal employed is a soft slack, and before being ground is passed through a Ruggles-Cole dryer. It is then conveyed to storage bins over the Fuller mills, into which it is discharged, and which grind it to a fineness of 95 per cent. through a No. 100 sieve. The ground coal is stored in tanks in front of the kilns and consumed as required. The cement grinding is accomplished in kominuters and tube mills. The finished cement is then passed through weighing scales, which fill, automatically discharge in two-barrel lots, and preserve the count. A belt conveyor carries the cement to the stockhouse, from

which it is withdrawn to the packing-house by return conveyors beneath the floor. The storage capacity is 125,000 barrels of finished cement and 75,000 barrels of clinker. Facilities for shipping cement and receiving coal and other supplies are provided by the Cement Company's standard gauge tracks giving connection with the Grand Trunk Railway for rail shipments and with the Cement Company's dock on the Welland Canal for water shipments.

The output of the plant is 1,500 barrels per day, and is shipped to the consumer in cotton or paper bags.

Power is obtained from the Ontario Niagara Power Company, and received at the transformer house at 12,000 volts pressure. It is then transformed for transmission over the low-tension wires of the plant to 480 volts. Individual motors are used to drive all the grinding machines, dryers and kilns. The advantages realized are many. A few of these may be mentioned: The loss of power in the line shafts is eliminated. The injury to bearings and belts through dust is reduced to a minimum.

The various steps in the process of manufacture can be arranged in their consecutive order, and in consequence the design is not hampered by a consideration of the power transmission system, as it is to some extent where line shafting is employed.

Any step in the process may be shut down without interfering with another part of the plant.

Centralization and convenience of speed control are rendered possible.

The cost of power for each step in the process may be obtained.

Motors in most cases are placed in rooms separate from the machines driven, in order to protect from dust as far as possible.

A well-equipped machine shop and forge for making repairs and a couple of saddle-back locomotives employed for hauling coal and raw materials to the works, and the finished product to the Welland Canal for shipment by water, complete the plant. These locomotives represent practically the only steam power employed around the works.

The designing of this very modern plant is the work of the F. L. Smidth & Co., of New York and in it the managing director, Mr. F. G. B. Allan, and the superintendent, Mr. D. N. Armstrong, take a very pardonable pride. The chief chemist is Mr. P. Belfour. The brand is "Star" Portland cement.

Don't miss the Chicago Cement Show at the Coliseum February 18 to 24.

The Art Portland Cement Co., of Kimmell, Ind., after having been shut down for over a year has been reorganized and will resume operations in the spring. The head office of the company which has been at Indianapolis, has been closed and the furniture taken to Kimmell. The Art Portland Cement Co. started up with one rotary kiln to manufacture White Portland Cement, several years ago, and after a short run it closed down, on account of slow demand for its product.

The Bellingham American of Bellingham, Washington, reports a sale of extensive limestone deposits at Rockport, Wash., to an eastern syndicate which is to build a cement plant on the property. Rockport is in the upper Skagit Valley on the line of the Great Northern Ry. Messrs. Janson & Johnson have purchased the town site of Rockport, hotel and general store and will make extensive improvement in the town.

The Western Canada Cement & Coal Co., located at Exshaw, 48 miles from Calgary, Alberta. The town being named after one of the cement companies' directors. The plant has 15 fireproof buildings and a modern equipment.

COST OF CONCRETE CONSTRUCTION AS APPLIED TO BUILDINGS.

Paper to the Fifth Annual Convention of the National Association of Cement Users at Cleveland, O., Jan. 11th to 16th, 1909, by Leonard C. Mason, President, Aberthaw Construction Company.

The writer is going to give in the course of this paper some actual job costs of various parts of building construction from his own experience. This kind of data is usually guarded with the greatest of care from every interested or curious eye outside the firm possessing it and often even from the trusted employee of the company. It is information usually known only to the manager or owners of a construction company and kept by them under lock and key.

It is not pure philanthropy on the writer's part to publish this cost data. If the selfish business motive is stated for so doing, perhaps more confidence may be placed in the figures given. Grenolithic pavements have been so long in use and so many contractors have lain them that their cost is a matter of common knowledge not only to all cement users but to the interested investing public. The result is that any contractor bidding a living profit above the actual cost of construction has a fair show of winning the job and the lowest bidder will usually make a profit. The same is true of building construction with brick and wood. Not so, however, is the case with concrete building construction. The art is too new to have methods or even designs standardized sufficiently to permit of cost data for present methods being very generally known. A great many builders are taking up this type of construction at the present time, some who are competent, many who are not. The novices under-estimate the cost and difficulties of doing good work, hence they bid unreasonably low, lose money and to some extent demoralize in true value of proper workmanship among architects, engineers and their clients. In the writer's opinion there is no class of construction where more painstaking skill and often technical knowledge is required than in reinforced concrete. When well done the resulting building is satisfactory to the owner beyond that obtained from any other material, and when poorly done is the least desirable, even if not actually dangerous. Concrete is either good or bad. There is no half way state, and the difference in cost of materials to the builder between perfect results and a dangerous structure is only five per cent. Therefore there is likely to be serious injury done to a rapidly growing industry by novices who either on account of ignorance, though coupled with honest, well meaning intent, or through skinning a job on which he is sure to lose money. Moreover, the older firm in the field have little to fear from the beginner because so much depends on personal ability as well as experience. With growing competition improvements are constantly being developed. The standard of cost is not yet fixed but is being reduced steadily. The desire of reducing the present wild bidding and having only intelligent competition as well as saving some poor builder a loss he cannot afford is the real inspiration of this paper. The author has undertaken it with the understanding that other competent writers would discuss it so that a greater good will result.

In order to have an intelligent understanding of the meaning of the figures hereinafter given, the method of collecting data will first be described. When making up an estimate of the cost of a building, in sealing the plans, it is found convenient to take off the volume of excavation and backfilling. The cubic feet of footings, foundations and wall, the square feet of forms for walls of foundations and above grade, the lineal feet of

belt courses, mouldings, cornices, etc. Also the size of special features of exterior treatment. Similarly the superficial area of column and floor forms are measured by themselves. Concrete of each different mixture is scaled off in cubic feet and totaled separately. Steel of each kind is taken off in pounds. Granolithic finished surfaces in square feet and so on in detail every item is measured. As the work progresses it is desired to know weekly how the actual experience compares with the estimate and at completion to compile correctly the costs of each item to compare with estimate and to aid in obtaining the true cost of future structures of a similar kind. The method of accounting was developed to fit the estimate.

In the year 1898 daily time reports were designed having a number of columns for ease in sub-dividing the time of the workmen. At the head of each column the time-keeper puts index numbers or letters to show the kind of work being done and below the actual time the men worked. On blank spaces at extreme right of the report the time-keeper inserts in writing the amount of each kind of work done and the amounts of the principal materials used. The experience of eight years has required no change whatever in the principles first adopted. The only change in the forms has been to increase the number of vertical columns so that a larger number of sub-divisions can be used without troubling the time-keeper to rewrite the names on another sheet. At the present time ten vertical columns are used for recording time with the names of the workmen at the extreme left, two columns being left at the right for the rate per hour and the total amount. At the beginning of a job written instructions are given as to how the work is to be sub-divided into items in the reports. A standard method of classification has been adopted as follows:

The principal sub-divisions are given a capital letter. Thus everything whatsoever relating to concrete masonry is given the index letter M, excavating of all kinds, including work incidental thereto, the letter D, all work connected with plant the letter P, and so on, there being only six or seven sub-divisions to indicate every building operation. To indicate the kind of work vowels are used. Thus the vowels beginning with "a" all relate to form work, as: "a," centering complete; when done by separate operations "aa" is making, "ae" is setting, "ai" is straightening up or bracing, "ao" removing after being used, and "au" cleaning up and handling ready to be used again. All labor connected with mixing and placing concrete or with handling materials for same goes under the head of "e," all work in connection with plant, receiving, erecting, taking down, shipping and repairing is indicated by the vowel "i." Thus "i" means receiving and setting up plant ready to work, "ia" taking down, removing and shipping, and "ie" repairing. The consonants are used to indicate differents parts of a structure in which certain work is done. Under classification "M," "b" stands for footings, "c" columns, "d" foundations, "f" floors, "g" stairs, etc. Under classification "P," "f" stands for boiler, "g" for horizontal engine, "h" for vertical hoisting engine, "l" for elevator, "m" for mixer, etc. Thus our time-keeper places at the head of a column when he is reporting concrete floors, for the placing of forms "Maaf," for concrete "Meaf." If a mixer is being set up ready to work the report would read "Pim" and later if it was repaired it would be reported under "Piem," etc. This is not so complicated to use as it may appear to read, and experience has proved that every man who knows enough to keep time can use the system with a few days experience. The principle is to make the least amount of clerical work to the timekeeper on the job, as they have plenty of other work to do. In addition to sub-division of time as above set forth, it is the duty of the timekeeper to report the number of barrels of cement mixed in a day, which is usually done by the man in charge of the mixer counting the empty bags, and in addition the actual volume of concrete measured in place. From this, knowing the proportions, it is a very simple matter to obtain the amount of sand and stone used and also to see if the right amount of cement is being used. Carpenter work on forms is reported by the number of square feet of surface in contact with the concrete erected. Thus walls are measured two sides without deducting doors and windows, as it is usual to let the form work run straight across these unless it is impossible on account of mouldings, in which case the framing of the opening will cost as much as the form work omitted. Beam floors are measured around the perimiter of the beam and the flat surface of the panel and around the perimiter of girders. No deduction is made for the loss of area by the intersection of beams and girders, and small openings in the floor are not deducted. Anything as large as an elevator or stairway is usually deducted. Form work for columns is measured for entire area of surface contact between wood and cement, all four sides. These reports are made out on the job daily and sent to the office. The book-keeper works these reports up into units of measurement, as cost of labor per cubic foot of concrete and number of cubic feet of concrete per barrel of cement, number of square feet of form work erected, etc., and from this it is easy to obtain the unit costs hereinafter given. The book-keeper can take the reports of four or five jobs, employing in the aggregate five or six hundred men, and in a single day work up the complete report for a week's time, thus it will be seen that there is really little extra labor involved in the subdividing of reports into a useful form over merely reporting the time so that the payroll can be accurately made. The system employed has appeared of sufficient value to others to warrant its being briefly outlined in Gillette's hand book on cost data, pages 14, 15, and 19, and a description of it also appeared in Engineering-Contracting of March, 1906. Materials received on the job are reported on cards especially printed for the purpose, listing the principal materials which are reported, in order to save work of the timekeeper in reporting materials accurately. When a job is entirely completed and the ledger account is closed, a master card is worked out giving the complete history of the cost. On one side of the card are written the items which went into the original estimate, such as excavation, back-fillings, footings, foundations, columns, floors, walls, stairs, etc., etc. In parallel columns is placed the actual amount of the estimate with the actual experience, reduced to cost units such as cubic feet, square feet of form work, etc., and the percentage of profits or loss between the estimate and actual results. On the reverse side of the card the principal items are worked out more in detail. Thus form work is reduced to cost of labor, lumber and nails, wire or other sundries used in the forms per square foot of surface. Concrete is itemized into the superintendent's general labor, labor of mixing and placing cost of cement, sand, stone miscellaneous expenses such as teaming, plant and other general items, reduced to cubic foot measurement, which makes the total cost of the concrete in place in each division of the building itemized for ready reference when making up future estimates on work of a similar character. An exhibit is given of these forms in an appendix.

It is well known that the cost of materials and labor in different parts of the country vary somewhat. Having the unit items all subdivided as above stated into their elementary parts, it is an easy matter after determining the cost of materials in any locality to make the exact corrections

to the results obtained on a previous job. Similarly, when a difference in the rate per hour for wages is known, if the same efficiency is obtained from the men it is very easy to make a correction, or if the efficiency varies, judgment must be applied to determine the correct rate to use. It has been the writer's experience that although the rate of wages and cost of materials vary somewhat in different parts of the country, the variations frequently offset one another so nearly that the sum total of the unit cost obtained in one place may be used in another, very seldom needing correction. For instance, within one month, after careful investigation, a bid was made up on a structure at San Juan, Porto Rico, using the same unit costs as for a building in Boston. In the report that is given, the costs relate to strictly first class material and workmanship in every case, as it has been the endeavor of the writer to establish and maintain one standard for all work. The variations in cost due to different mixtures of concrete can easily be allowed for by reference to the table on page 133 of the proceedings of the Fourth Annual Convention of this Association. In general would say that the standard mixture for all floors has been either 1-3-6, or 1-2-4 if the floor is subjected to extremely heavy loads and service. Walls are mixed 1-3-6 and columns usually 1-2-4; in some cases where they are very heavily loaded a richer mixture is used. As these mixtures are common to nearly all construction the costs here given may be applied with little danger of error from neglecting the mixture on any work. Of course it can readily be understood that in the large number of jobs which have entered into the averages given, there being as many as eighteen in the case of beam floors, different methods of conducting the work have been used and many different foremen. Therefore, while the general average is doubtless safe for any work of an average character, some latitude may be allowed the judgment in determining whether any specific case is likely to be difficult, easy or average. The writer has found quite a difference, for instance, in cost of identical work handled by different foremen, due to the personal quotation of their painstaking, supervision and ability.

In the following tables only typical jobs are given, whose results are correctly known. The results of a number of jobs have been spoiled by a change of timekeeper during the progress of the work, the new man missing for a day or two the proper classification or some other such small matter. It appears to the writer, moreover, that the results from a few typical jobs would be of more interest

SUMMARIZED RECORDS OF VARIOUS CONTRACTS.

CONCRETE COLUMNS.

BASIS OF SUMMARY	Forms per square foot. Carpenter Labor	Lumber	Nails and Wire	TOTAL	Concrete per cubic foot. Concrete Lumber	General Labor	Cement	Aggregate	Team and Misc.	Plant	TOTAL.
Highest	.133	.082	.002	.181	.166	.056	.109	.084	.041	.034	.340
Lowest	.057	.013	.001	.075	.064	.003	.062	.027	.008	.013	.271
Average of 9	.082	.036	.001	.130	.096	.027	.085	.049	.021	.023	.301
BEAM FLOORS OF REINFORCED CONCRETE											
Highest	.165	.107	.004	.275	.186	.035	.194	.101	.052	.055	.470
Lowest	.037	.027	.001	.067	.047	.004	.071	.037	.007	.010	.202
Average of 18	.070	.045	.002	.116	.111	.020	.106	.063	.025	.024	.354
FLAT SLAB FLOORS.											
Highest	.078	.039	.003	.118	.146	.017	.109	.084	.026	.039	.374
Lowest	.067	.037	.001	.106	.043	.004	.087	.053	.012	.010	.252
Average	.071	.038	.002	.111	.097	.009	.096	.070	.019	.024	.315
CONCRETE SLABS BETWEEN STEEL BEAMS.											
Highest	.110	.071	.003	.184	.144	.048	.208	.080	.064	.046	.428
Lowest	.028	.012	.001	.049	.073	.005.	076	.026	.004	.010	.272
Average	.061	.032	.002	.095	.102	.019	.128	.068	.024	.017	.359
BUILDING WALLS ABOVE GRADE.											
Highest	.136	.073	.005	.176	.146	.052	.105	.187	.077	.055	.446
Lowest	.046	.016	.001	.079	.042	.004	.034	.043	.007	.005	.174
Average of 17	.085	.036	.002	.128	.090	.016	.073	.076	.025	.019	.301
FOUNDATION WALLS.											
Highest	.134	.048	.004	.193	.213	.037	.203	.116	.057	.040	.599
Lowest	.032	.009	.001	.056	.040	.002	.038	.027	.003	.010	.148
Average of 14	.068	.033	.002	.103	.076	.015	.080	.062	.019	.017	.269
FOOTING AND MASS FOUNDATIONS.											
Highest	.119	.077	.003	.198	.081	.020	.098	.099	.013	.049	.275
Lowest	.016	.006	.001	.018	.025	.001	.047	.043	.003	.010	.181
Average of 10	.057	.034	.002	.093	.045	.007	.071	.077	.007	.021	.229

STEEL.

Highest	Cost per ton	$16.47
Lowest	" " "	2.54
Average of 21	" " "	8.52

than a mass of figures from all kinds, some of which would be of no value. Enough are given for a fair average, except in the case of long span flat slab, which is, by comparison, a recent type of construction.

By reference to the general averages on form work in the foregoing tables of forms per square foot of surface contact, namely, column $.13 floors with re-inforced concrete beams $.116, flat floors without beams $.111, short span slabs between steel beams including the fireproofing on the sides of the beam $.095, walls exposed to view above ground, $.128, foundation walls $.103, mass foundations $.093, the writer believes all higher in price than usually believed to be a fair cost by the majority of builders. It is upon the success of handling forms that good results financially depend. In regard to concrete, labor is the variable item which must be carefully considered. Anyone of intelligence can make a careful estimate of the materials to be used, but note the average prices per cubic foot of labor, namely for columns, $.123, beam floor $.131, flat floor $.106, floors between steel beams $.121, walls $.106, foundation $.091 and mass work in connection with buildings $.052; not until the last item is reached is a price obtained in experience which, according to the observation of the writer, the majority expect to obtain in building work in general. Many men who have had wide experience in handling large quantities of concrete in mass have at times attempted a lighter type of construction and been greatly surprised at the large expense connected therewith. It has come to the writer's notice a number of times that men with this experience have added 50 per cent. to 100. per cent. to the cost of mass work and felt that they were amply covered for light structural work. The fallacy of this can be seen by a very recent experience of the writer's. In building a dam this past year across the Connecticut River about 5,500 cubic yards of concrete were placed. Cement and aggregates were received on a bridge abutment 26 feet above the river. Aggregates were dumped upon an inclined chute where they were to be washed, and from the end of the chute they fell into bins, from which they were drawn through measuring hoppers into a mixer and dumped from this into tram cars four feet above the water. The total expense for labor of washing, charging, mixing and dumping into the

cars was only $.12 per cubic yard and for moving it in cars an average distance of 700 feet, dumping and placing was only $.30 per cu. yd., or a total cost of $.0155 per cubic foot. The table of steel omits entirely the first cost of the material. After it is received at the site of the work in the shape sold by the manufacture, these prices cover the cost of fabricating into units for columns or beams, bending the stirrups, placing and all incidentals whatsoever prior to the actual embedding in concrete. In the case of the highest cost, a coal pocket, there was very limited storage space, 1¼ inch bars had to be bent diagonally so as to pass over the top of the support at columns, and numerous stirrups, all of which had to be made by hand. The job was too small to justify any mechanical arrangement for bending or for handling material. The next highest office building, Portland, Me., there was a sufficient amount to require proper machinery. The hoops for columns were all welded. The vertical bars were all wired inside of these hoops. There was a mushroom head of bent and circular bars wired together at the top and great numbers of long bars of small section spread in all directions over the floor. The lowest price, filter at Lawrence, was made entirely of straight bars placed loose, the only expense being cutting them in a hand shear to length and placing them.

In the exhibit at the end is given an exact copy of a "master card" which gives the complete financial history of the job when it is finally completed. Photographs of this particular building are given for aid in understanding the explanation. The first column, which is blank, is occasionally used for an estimate of the first cost, the proposal including the profit as well as the estimated actual cost. It will be seen that on some items a loss was incurred, as well as a profit on others, showing that it is difficult, even on work which a company is fairly experienced on, to reach the right price on everything, and also that when slight changes are made by the owner or architect they often entail heavy loss even though the changes appear to be extremely trivial. Take the case of the external walls. The owners furnished the window frames and sash, which were all of metal. The original design was for a frame with two sash, which could easily be put into a 6-inch wall. They later decided, for greater fire protection, to use four sash. This required an eight inch wall instead of six inch, and as will be seen in the picture the form work on the inside had to be built inward and then the space under the windows paneled to save material. To save making a very narrow panel at the side of the window, which would cost more than the concrete saved, the space was filled up solid so that the columns appear to be wider than they were actually figured. This slight change, which did not appear great at the time, when the job was entirely complete showed that the concrete on the walls showed an actual loss instead of profit and that the form work cost more than twice what was originally estimated it should cost.

Regarding the tooling of wall surfaces, we originally planned to do this when the cement was less than ten days old, but on account of the various changes forms had to be left on a considerably longer time and it was inconvenient to tool the surface until the cement was so thoroughly set that the cost of dressing was considerably greater than was first anticipated. Again, by reference to the ⅞ inch maple floor which was placed upon the concrete construction, a cost of $89.44 per M.bd. ft. will be observed, and by reference to the details on the back of the card it will be seen that repairing floor cost $248.50, or $12.42 per thousand. This was due to the fact that the owners did not deliver or set the window sash at the time agreed and therefore the maple floors lay exposed to the weather in the building for several weeks, swelled and after laying shrunk, leaving large cracks which the owners insisted on being filled before they would accept the work. These indicate how matters which appear trivial at the time may cause serious loss if overlooked.

As seen by the large list of items entering into the estimate as given by this master card, there are various items of cost entering into the construction besides those which are enumerated. Nevertheless the matter of the forms, steel and concrete covers by far the largest proportion of the cost of a re-inforced concrete structure and the minor items are those which are peculiar to each individual case and which any person can easily estimate for himself.

Job No. 747
Date May 24th. 1906. Mill, Tappan Bros., Attleboro, Mass.

	PROPOSAL	ACTUAL COST	PER CU. FT.	PROFIT	LOSS	PER CENT
Total	35164.55	31330.48		3834.07		11
Excavate	790.	823.18	.021		33.18	
Footings & Fn.	1738.	1033.57	.137	704.43		
			Per Sq. Ft.			
Exterior Walls	1955.	2162.02	.190		207.02	
Walls & Fn. Centers	1520.	3630.08	.125		2110.08	
Floors 6⅜" thick	8883.	6544.16	.339	2338.84		
Roof 5¼" thick	2869.	1713.51	.237	1155.49		
			Per L. Ft.			
Columns 20" x 20"	832.	676.65	1.470	155.35		
Stairs	883.	910.35	.912		27.35	
Tool Surface	469.	636.53	.056—Per sq ft.		167.53	
Ornaments & Cornice	348.	164.33		183.67		
Ventilators on Roof	44.	35.64		8.36		
Set Windows & Door						
			Each			
Frames	852.	729.99	2.19	122.01		
			Per Sq. Ft.			
Interior Partitions	1770.25	1656.35	.189	113.90		
Bolts & Iron Works	253.	257.06			4.06	
Stair Railing & Grill	387.	654.			267.	
			Per M.			
Screens & Setting	1086.	835.12	52.17	250.88		
2" Spr. Plank & Laying	2839.	1431.69	33.30	1407.31		
⅞" Maple	1738.	1788.88	89.44		50.88	
Motor Shaft	379.50	533.19	98.89		153.69	
Motor Shaft Found	98.	70.07		27.93		
Roofing & Conductors	1255.	1026.06		228.94		
			Per Sq. Ft.			
Paving	1009.	647.54	.094	361.46		
Retaining Wall						
Centers per sq. ft.			.211			
Concrete per cu. ft.	429.	316.90	.175	112.10		
Painting	400.	375.		25.		
Steel Footing & Walls	300.	218.91		81.09		
Plant, frt. etc.	1860.	2271.73			411.73	
Bond	100.	120.			20.	
Extras	77.30	67.97		9.83		

LIST AND LOCATION OF
Cement Mills in Operation 1909.

United States.

Alabama Portland Cement Co.
Office and works, Spocari, Ala.
Capacity, 150,000 bbls. yearly.

Alamo Portland Cement Co.
Office and works, San Antonio, Tex.
Capacity, 250 bbls. per day.

Alma Cement Co.
Office and works, Wellston, O.
Capacity, 500,000 bbls. yearly.

Alpena Portland Cement Co.
Office and works, Alpena, Mich.
Capacity, 350,000 bbls. yearly.

Alpha Portland Cement Co.
Office, Easton, Pa.
Works, Alpha, N. J. and Martin's Creek, Pa.
Capacity, 5,000,000 bbls. yearly.

Alsen's American Portland Cement Works.
Office, 45 Broadway, New York.
Works, Alsen, N. Y.
Capacity, 1,300,000 bbls. yearly.

American Cement Co.
Office, Pennsylvania Bldg., Philadelphia.
Works, Egypt, Pa., and Lesley, Pa.
Capacity, 2,200,000 bbls. yearly.

Art Portland Cement Co.
Office and works, Kimmell, Ind.
Capacity, 500,000 bbls. yearly.

Ash Grove Lime & Portland Cement Co.
Office, R. A. Long Bldg., Kansas City, Mo.
Works, Chanute, Kansas.
Capacity, 750,000 bbls. yearly.

Atlas Portland Cement Co.
Office, 30 Broad St., N. Y.
Works, Northampton, Pa., and Hannibal, Mo.
Capacity 14,000,000 bbls. yearly.

Bath Portland Cement Co.
Office and works, Bath, Pa.
Capacity, 985,000 bbls. yearly.

Berkshire White Portland Cement Co.
Office, 21 Park Row, N. Y.
Works, Clayton, Mass.
Capacity, 36,000 bbls. yearly.

Bonner Portland Cement Co.
Office, Kansas City, Mo.
Works, Bonner Springs, Kans.
Capacity, 547,000 bbls. yearly.

Bonneville Portland Cement Co.
Office, Land Title Bldg., Philadelphia, Pa.
Works, Siegfried, Pa.
Capacity, 400,000 bbls. yearly.

Buckeye Portland Cement Co.
Office, Bellefontaine, O.
Works, Harper, Logan Co., O.
Capacity, 100,000 bbls. yearly.

Buckhorn Portland Cement Co.
Office, 2241 N. American St., Phila. Pa.
Works, Manhem, Preston Co., W. Va.
Capacity, 300,000 bbls. yearly.

Burt Portland Cement Co.
Office and works, Bellevue, Mich.
Capacity, 500,000 bbls. yearly.

California Portland Cement Co.
Office, Trust Bldg., Los Angeles, Calif.
Works, Colton, Calif.
Capacity, 750,000 bbls. yearly.

Castalia Portland Cement Co.
Office, Publication Bldg., Pittsburg, Pa.
Works, Castalia, Erie Co., Ohio.
Capacity, 400,000 bbls. yearly.

Catskill Cement Co.
Office and works, Cementon, N. Y.
Capacity, 325,000 bbls. yearly.

Cayuga Lake Cement Co.
Office, Ithaca, N. Y.
Works, Portland Point, N. Y.
Capacity, 250,000 bbls. yearly.

Chanute Cement and Clay Products Co.
Office, 1004 East Market St., Akron, O.
Works, Bronson, Mich.
Capacity, 300,000 bbls.

Chicago Portland Cement Co.
Office, 108 La Salle St., Chicago, Ill.
Works, Oglesby, Ill.
Capacity, 1,000,000 bbls. yearly.

Coplay Cement Mfg. Co.
Office, Pennsylvania Bldg., Philadelphia, Pa.
Works, Coplay, Pa.
Capacity, 1,250,000 bbls. yearly.

Continental Portland Cement Co.
Office and works, St. Louis, Mo.
Capacity, 3,000 bbls. daily.

Crescent Portland Cement Co.
Office and works, Wampum, Pa.
Capacity, 100,000 bbls. yearly.

Dewey Portland Cement Co.
Office, Scarritt Bldg., Kansas City, Mo.
Works, Dewey, Okla.
Capacity 750,000 bbls. yearly.

Dexter Portland Cement Co.
Office and works, Nazareth, Pa.
Capacity, 800,000 bbls. yearly.

Diamond Portland Cement Co.
Office, Williamson Bldg., Cleveland, O.
Works, Middle Branch, Stark Co., O.
Capacity, 350,000 bbls. yearly.

Dixie Portland Cement Co.
Office, Iola, Kans.
Works, South Pittsburg, Tenn.
Capacity, 1,500,000 bbls. yearly.

Edison Portland Cement Co.
Office, Stewartsville, N. J.
Works, New Village, N. J.

Egyptian Portland Cement Co.
Office and works, Fenton, Mich.
Capacity, 400,000 bbls. yearly.

Elk Cement and Lime Co.
Office and works, Elk Rapids, Mich.
Capacity, 300,000 bbls. yearly.

Empire Portland Cement Co.
Office, Franklin, Pa.
Works, Warners, N. Y.
Capacity, 125,000 bbls. yearly.

Fredonia Portland Cement Co.
Office and works, Fredonia, Kans.
Capacity, 240,000 bbls. yearly.

German-American Portland Cement Co.
Office and works, La Salle, Ill.
Capacity, 1,000,000 bbls. yearly.

Glens Falls Portland Cement Co.
Office and works, Glens Falls, N. Y.
Capacity, 684,000 bbls. yearly.

The Hecla Co.
Office, Penobscot Bldg., Detroit, Mich.
Works, Bay City, Mich.
Capacity, 450,000 bbls. yearly.

Helderberg Cement Co.
Office, 78 State St., Albany, N. Y.
Works, Howe Cave, N. Y.
Capacity, 500,000 bbls. yearly.

Hudson Portland Cement Co.
Office and works, Hudson, N. Y.
Capacity, 500,000 bbls. yearly.

Huron Portland Cement Co.
Office, Ford Bldg., Detroit, Mich.
Works, Alpena, Mich.
Capacity, 1,200,000 bbls. yearly.

Iola Portland Cement Co.
Office and works Iola, Kans.
Capacity, 2,000,000 bbls. yearly.

Ironton Portland Cement Co.
Office and works, Ironton, O.
Capacity, 300,000 bbls. yearly.

Kansas City Portland Cement Co.
Office, Kansas City, Mo.
Works, Cement City, Mo.

Kosmos Portland Cement Co.
Office and works, Kosmosdale, Ky.
Capacity, 500,000 bbls. yearly.

Lawrence Cement Co.
Office and works, Siegfried, Pa.
Capacity, 1,200,000 bbls. yearly.

Lehigh Portland Cement Co.
Office, Allentown, Pa.
Works, Ormrod, Pa.; West Coplay, Pa.; Fogelsville, Pa.; New Castle, Pa.; Wellston, O.; Mitchell, Ind.
Capacity, 7,500,000 bbls. yearly.

Louisville Cement Co.
Office, Louisville, Ky.
Works, Speeds, Ind.
Capacity, 500,000 bbis. yearly.

Marengo Portland Cement Co.
Office, Youngstown, O.
Works, Caledonia, N. Y.
Capacity, 650,000 bbls. yearly.

Marquette Cement Mfg. Co.
Office and works, La Salle, Ill.
Capacity, 1,000,000 bbls. yearly.

Maryland Portland Cement Co.
Office, Equitable Bldg., Baltimore, Md.
Works, Security, Md.
Capacity, 250,000 bbls. yearly.

Thomas Millen Co.
Office and works, Wayland, N. Y.
Capacity, 125,000 bbls. yearly.

Nazareth Cement Co.
Office and works, Nazareth, Pa.
Capacity, 1,000,000 bbls. yearly.

New Aetna Portland Cement Co.
Office, Union Trust Bldg., Detroit, Mich.
Works, Fenton, Mich.
Capacity, 350,000 bbls. yearlv.

Newaygo Portland Cement Co.
Office, Grand Rapids, Mich.
Works, Newaygo, Mich.
Capacity, 400,000 bbls. yearly.

Northampton Portland Cement Co.
Office and works, Stockertown, Pa.
Capacity, 500,000 bbls. yearly.

Northwestern States Portland Cement Co.
Office, Jackson, Mich.
Works, Mason City, Iowa.
Capacity, 1,500,000 bbls. yearly.

Oklahoma Portland Cement Co.
Office and works, Ada, Oklahoma.
Capacity, 350,000 bbls yearly.

Omega Portland Cement Co.
Office, Jonesville, Mich.
Works, Mosherville, Mich.
Capacity, 175,000 bbls. yearly.

Pacific Portland Cement Co.
Office, Pacific Bldg., San Francisco, Calif.
Works, Cement, Solano Co., Cal.
Capacity, 1,750,000 bbls. yearly.

Peerless Portland Cement Co.
Office and works, Union City, Mich.
Capacity, 425,000 bbls. yearly.

Penninsular Portland Cement Co.
Office, Jackson, Mich.
Works, Cement City, Mich.
Capacity, 400,000 bbls. yearly.

Penn-Allen Portland Cement Co.
Office, Allentown, Pa.
Works, Nazareth, Pa.
Capacity, 700,000 bbls. yearly.

Pennsylvania Cement Co.
Office, 26 Cortlandt St., New York City.
Works, Bath, Pa.
Capacity, 750,000 bbls. yearly.

Phœnix Portland Cement Co.
Office and works, Nazareth, Pa.
Capacity, 350,000 bbls. yearly.

The Portland Cement Co.
Office, Denver, Colo.
Works, Portland, Colo.
Capacity, 700,000 bbls. yearly.

Portland Cement Co. of Utah Ltd.
Office and works, Salt Lake City, Utah.
Capacity, 125,000 bbls. yearly.

St. Louis Portland Cement Co.
Office, Liggett Bldg., St. Louis, Mo.
Works, Prospect Hills, St. Louis, Mo.
Capacity, 1,250,000 bbls. yearly.

Sandusky Portland Cement Co.
Office, Sandusky, O.
Works, Bay Bridge, O.; Syracuse, Ind.; Dixon Ill.; York, Pa.
Capacity, 1,500,000 bbls. yearly.

Santa Cruz Portland Cement Co.
Office, Crocker Bldg., San Francisco, Calif.
Works, Davenport, Calif.
Capacity, 4,320,000 bbls. yearly.

Southern States Portland Cement Co.
Office and works, Rockmart, Ga.
Capacity, 400,000 bbls. yearly.

Standard Portland Cement Co.
Office, Charleston, S. C.
Works, Leeds, Ala.
Capacity, 200,000 bbls. yearly.

Standard Portland Cement Corporation.
Office, Crocker Bldg., San Francisco, Calif.
Works, Napa Junction, 1,260,000 bbls. yearly.
Capacity, 1,260,000 bbls. yearly.

Superior Portland Cement Co.
Office and works, Baker, Wash.
Capacity, 250,000 bbls. yearly.

The Superior Portland Cement Co.
Office, Charleston, W. Va.
Works, Superior. Lawrence Co., O.
Capacity, 700,000 bbls. yearly.

Texas Portland Cement Co.
Office, Wilson Bldg., Dallas, Texas.
Works, Cement, Texas.
Capacity, 1,500,000 bbls. yearly.

Union Portland Cement Co.
Office, Ogden, Utah.
Works, Devils Slide, Utah.
Capacity, 750,000 bbls. yearly.

United Kansas Portland Cement Co.
Office, Iola, Kans.
Works, Iola, Kans.; Independence, Kans.; Neodesha, Kansas.
Capacity, 3,000,000 bbls. yearly.

United States Cement Co.
Office, and Works, Lehman, Ind.
Capacity, 750,000 bbls. yearly.

U. S. Portland Cement Co.
Office, Dwight Bldg., Kansas City, Mo.
Works, Yocemento, Kans.
Capacity, 400,000 bbls. yearly.

Universal Portland Cement Co.
Office, Commercial Bank Bldg., Chicago, Ill.
Works, South Chicago, Ill.; and Universal, nr. Pittsburg, Pa.
Capacity, 6,000,000 bbls. yearly.

United States Cement Co.
Office and works, Lehman, Ind.
Capacity ,750,000 bbls. yearly.

Vindex Portland Cement Co.
Office and works, Molltown, Pa.
Capacity, 216,000 bbls. yearly.

Virginia Portland Cement Co.
Office, 5 Nassau St., New York, N. Y.
Works, Fordwick, Va.
Capacity, 1,000,000 bbls. yearly.

Vulcanite Portland Cement Co.
Office, Land Title Bldg., Philadelphia, Pa.
Works, Vulcanite, N. J.; P. O. Phillipsburg, N. J.
Capacity, 1,600,000 bbls. yearly.

Wabash Portland Cement Co.
Office, Ford Bldg., Detroit, Mich.
Works, Stroh, Ind.
Capacity, 400,000 bbls. yearly.

Washington Portland Cement Co.
Office and works, Concrete, Wash.
Capacity, 240,000 bbls. yearly.

Western Portland Cement Co.
Office, 135 Grand ave., Milwaukee, Wis.
Works, Yankton, S. D.
Capacity, 300,000 bbls. yearly.

Western States Portland Cement Co.
Office, Jackson, Mich.
Works, Independence, Kans.
Capacity, 1,200,000 bbls. yearly.

Whitehall Portland Cement Co.
Office, Land Title Bldg., Philadelphia, Pa.
Works, Cementon, Lehigh Co., Pa.
Capacity, 1,250,000 bbls. yearly.

Wolverine Portland Cement Co.
Office, Coldwater, Mich.
Works, Quincy and Coldwater, Mich.
Capacity, 800,000 bbls. yearly.

Wyandotte Portland Cement Co.
Office, Ford Bldg., Detroit, Mich.
Works, Wyandotte, Mich.
Capacity, 300,000, bbls. yearly.

York Portland Cement Co.
Office and Works, Portsmouth, O.
Capacity, 350,000 bbls. yearly.

Canada.

Alberta Portland Cement Co.
Calgary, Alberta.

Belleville Portland Cement
Belleville, Ont.

Brant Portland Cement Co.
Brantford, Ont.

Canadian Portland Cement Co.
Office, Toronto, Ont.
Works, Port Colborne, Ont.

Colonial Portland Cement Co.
Wiarton, Ont.

Commercial Cement Co., Ltd.
Office, 433 Main St., Winnipeg.
Works, Babcock, Man.

Grey & Bruce Portland Cement Co.
Owen Sound, Ont.

Hanover Portland Cement Co. Ltd.
Hanover, Ont.

International Portland Cement Co.
Hull, Que.

Imperial Portland Cement Co.
Owen Sound, Ont.

Lakefield Portland Cement Co.
Office, Montreal, Que.
Works, Montreal, Quebec and Lakefield, Ont.

Lehigh Portland Cement Co.
Office, Toronto, Ont.
Works, Belleville, Ont.

National Portland Cement Co.
Durham, Ont.

Ontario Portland Cement Co.
Brantford, Ont.

Owen Sound Portland Cement Co.
Owen Sound, Ont.

Port Colborne Portland Cement Co.
Toronto, Ont.

Raven Lake Portland Cement Co.
Victoria Road, Ont.

Sun Portland Cement Co.
Owen Sound, Ont.

Sydney Portland Cement Co.
Sydney, Nova Scotia.

Vancouver Portland Cement Co.
Victoria, British Columbia.

Vulcan Portland Cement Co.
Montreal, Que.

Western Portland Cement Co.
Atwood, Ont.

Western Coal, Lime & Cement Co.
Calgary, Alberta.

The Western Canada Cement & Coal Co.
Exshaw, Alberta.

New Zealand.

Milburn Lime & Cement Co.
Dunedin, N. Z.

New Zealand Portland Cement Co.
Auckland, N. Z.

John Wilson & Co.
Head office, Auckland, N. Z.
Factory office, Warkworth, N. Z.

Cuba.

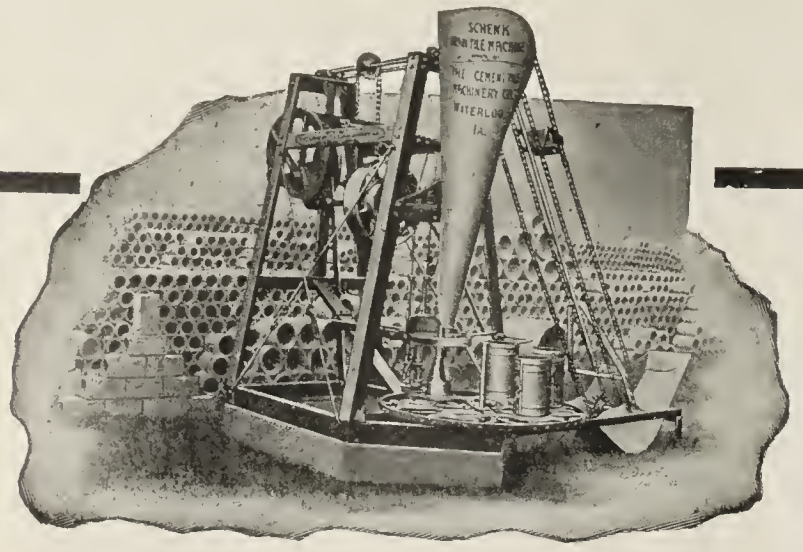
El Almendares Portland Cement Co. Havana.

Mexico.

Arenzana & Co.,
Mexico City, Mex.

Bancaria de Obras Portland Cement Co.
Dublan, Hidalgo, Mex.

Monterey Steel & Iron Co.,
Monterey, Nuevo Leon, Mex.



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Ceylon, Minn., Oct. 7, 1908.

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We have owned and operated a Schenk Tile Machine for three years and same has been giving better satisfaction for each succeeding year. We find that the machine will do all that is claimed for it and after investigating several tile machines we have decided that the Schenk machine is far superior to any other machine on the market. In fact it is the only machine. We have always found The Cement Tile Machinery Co., of Waterloo, courteous and fair in all their dealings with us, and we are pleased to speak a good word for them and their machine wherever we can.

Yours truly,
CEYLON CEMENT TILE CO.,
Per D. G. Keith, Sec.

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The Cement Tile Machinery Co.

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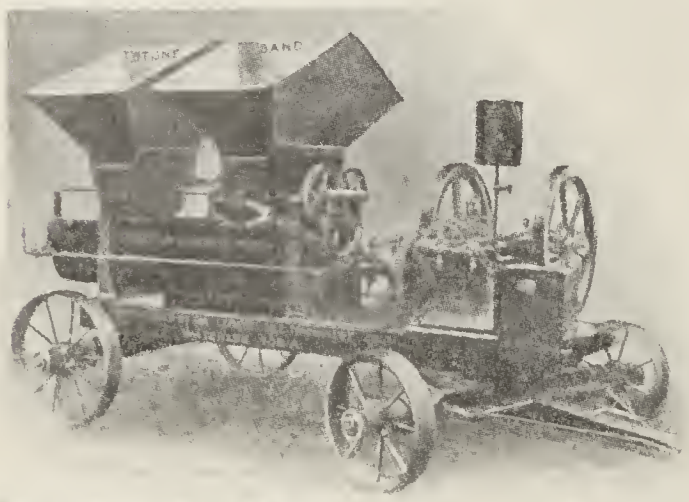

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CEMENT

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ENGINEERING NEWS

AN ARTISTIC EXHIBIT OF ORNAMENTAL

CONCRETE WORK.

CEMENT AND ENGINEERING NEWS

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JOHN F. WALDRON, Advertising Manager

CHICAGO, FEBRUARY, 1909.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experiments will be welcome.

THE AMERICAN CEMENT INDUSTRY.

The cement industry in 1908 was not so prosperous or remunerative as in preceding years, due in a great measure to the financial stringency brought about by the hasty and injudicious repressive measures instituted by the Government against railways and other large corporations; resulting in undermining the confidence of capital, thus preventing railway promotion and the betterment of existing lines, as well as placing a damper on our entire manufacturing industry. Millions of dollars of railway work under way was suspended; factories and shops full of orders were compelled to close down; building enterprise throughout the country was greatly curtailed to an extent never before equalled. This panic of Jingo political origin, caused directly and indirectly more damage and loss in money and lives than all of the earthquakes and cyclones that ever visited this country. The cement industry felt the shock in common with other manufacturing enterprises; consumption was restricted, and prices reduced on one hand, yet the reduction of prices on cement created a demand for this commodity which at higher prices would not have been used in new work. Many newly projected cement plants were arrested in their operations, because the Companies bonds could not be floated. The cement plant promotor was retired for a time. However these promoters are again in the field, as well as new projects, and new plants under way; some completed, showing that the cement industry has again the confidence of capital as a gilt edged investment. The old plants in favorable locations, are and have been undergoing enlargements.

No one can foretell the magnitude the cement industry is to assume in the future; it will certainly not go backward. This industry has passed the experimental stage, and is passing into strong hands, and will be operated in larger units than in the past, and also operated by highly trained experts. Small plants as a rule, may be considered as being out of date from an economical standpoint. The demand for cement under normal conditions, must and will increase as the public becomes educated to its use. To educate the public, must be one of the great aims of this industry. One of the leading educational methods is to be found in the display of machinery and cement ware products at the annual cement shows or conventions. In our opinion these great exhibits are really of greater value than the technical papers read at these conventions, since they teach the cement maker and public the use of labor saving devices which at once cheapen as well as improve the appearance of the product, and this is what the consumer wants. The aim of the cement manufacturer is to increase the consumption of his product, and this is what the machinery end and the cement product end of our annual cement shows are accomplishing, in the most practical way. The office of the highly trained laboratory cement expert outside of the mills, is to keep the flow from the mills to the consumer pure and sound and to prescribe certain methods of construction for the cement works, in order to insure good sound results in the use of cement, all of which will conduce to the growth of the industry as a whole.

The annual meeting of the Humboldt Portland Cement Company, Humboldt, Kan., was held on January 6. The directors were instructed to contract with the Freeborn Engineering & Construction Company, of Kansas City, Mo., for the construction of the plant. A. D. Kendall, Mound Valley, Kan., president; John W. Berry, Humboldt, Kan., secretary.

APPARATUS FOR BURNING FUEL IN FURNACES.

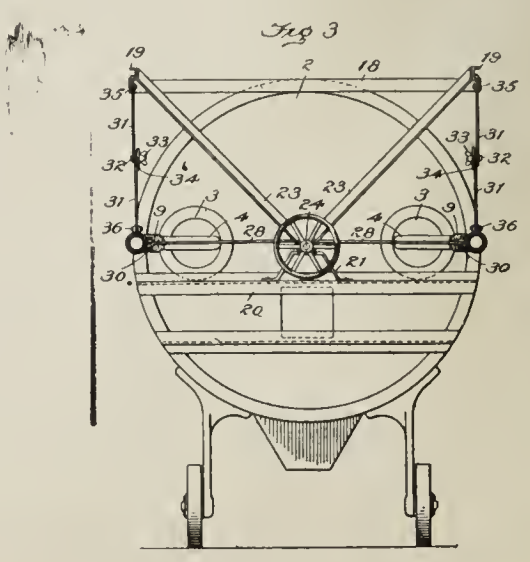
Mr. E. M. Bunce, superintendent of the New Aetna Portland Cement Company, Fenton, Mich., has invented new and useful improvements in apparatus for burning fuel in furnaces for which he has been granted a patent. He has the following to say in regard to his invention: "This apparatus will particularly appeal to manufacturers of cement in rotary kilns. It has been practically demonstrated at the plant of the New Aetna Portland Cement Company for the past few months and has proven satisfactory beyond any expectation. It has shown that it would effect a saving of between ten and fifteen per cent in full and has also eliminated 90 per cent of former "ringing up" troubles, that are contended with in the use of the ordinary apparatus. It is simple in operation and construction and I will be pleased to answer any inquiries regarding its arrangement.

The object of my invention is the provision of apparatus or means for burning fine fuel in suspension, such as pulverized coal, when mixed with air, in a furnace, and especially in rotary kilns, whereby relatively complete combustion may be secured by thoroughly mixing the fuel with the air, and whereby when the apparatus is used in connection with a rotary or other kiln for burning Portland cement clinker the intensity of the flame or heat may be localized at various points or places inwardly from the extreme lower end of the kiln, and said flame also may be directed towards any portion of the internal surface of the kiln as well as axially thereof.

The invention consists in certain novelties of construction and combinations of parts hereinafter set forth and claimed.

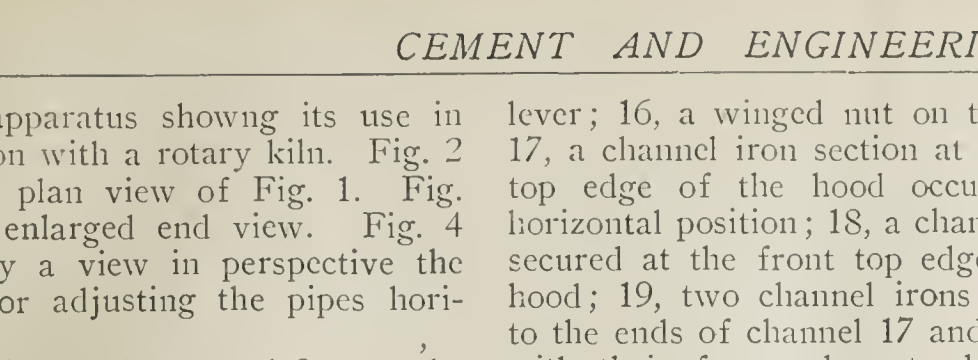
The accompanying drawings illustrate one example of the physical embodiment of the invention constructed and arranged according to the best of the several modes I have so far devised for the practical application of the principle.

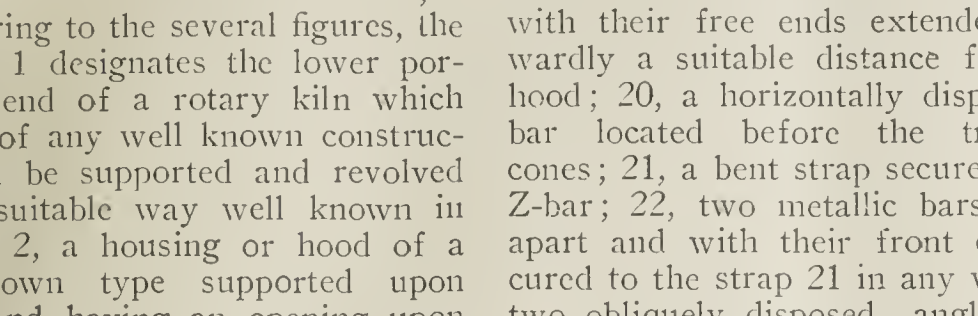
Figure 1 is a side view in elevation



the apparatus showng its use in nnection with a rotary kiln. Fig. 2 a top plan view of Fig. 1. Fig. is an enlarged end view. Fig. 4 ows by a view in perspective the eans for adjusting the pipes hori-ntally.

Referring to the several figures, the meral 1 designates the lower por-on or end of a rotary kiln which ay be of any well known construc-on and be supported and revolved any suitable way well known in e art; 2, a housing or hood of a ell known type supported upon heels and having an opening upon ne vertical side which in this instance ceives or matches the tubular end f the rotary kiln; 3, two castings set the wall of the hood and extend-g through the fire brick, indicated y dotted lines, each casting being a ollow truncated cone in shape and



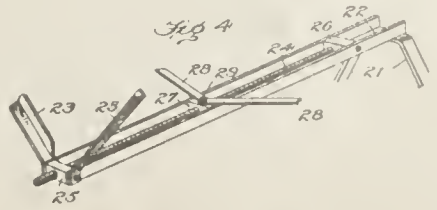


he axial lines of the two cones dis-osed at an angle to each other; 4, uel discharge pipes with their ends cated within and slightly projecting eyond the smaller ends of the trun-ated cones, thus forming swivel con-ections with said cones; 5, retain-g bands or rings upon the ends of he pipes for preventing their with-rawal from the cones; 6, the main last pipe connected with a blower nd source of fuel supply; 7, 7, the wo branches leading from the main last pipe; 8, sections of pipe consti-uting continuations of the branches the fuel discharge pipes; 9, flexible ose connecting the several pipes whereby three universal joints are rovided between each branch of the ain pipe and the fuel discharge pipe; 0, rods for supporting the end of he main pipe and the several branch ipes; 11, a damper located within he main pipe at its junction with the ranches; 12, the shaft; 13, a perfor-ted lever arm; 14, a slotted semi-cir-ular bearing supported by the main ipe; 15, a bolt passed through the lot in the circle and the end of the lever; 16, a winged nut on the bolt; 17, a channel iron section at the rear top edge of the hood occupying a horizontal position; 18, a channel iron secured at the front top edge of the hood; 19, two channel irons secured to the ends of channel 17 and 18 and with their free ends extended rearwardly a suitable distance from the hood; 20, a horizontally disposed Z-bar located before the truncated cones; 21, a bent strap secured to the Z-bar; 22, two metallic bars spaced apart and with their front ends secured to the strap 21 in any way; 23, two obliquely disposed angle irons extending from the ends of the channels 19 to the ends of the bars 22, and which support the ends of said bars; 24, a threaded shaft with a hand wheel; 25, a perforated block which supports the hand wheel end of the shaft and within which the shaft is loosely journaled; 26, a fixed block having a bearing for the end of the shaft and within which the end of the shaft turns; 27, a movable block with a threaded hole for the reception of the threaded portion of the shaft; 28, two toggle levers; 29, a journal by which the meeting ends of the levers are pivoted to the movable block; 30, pivotal joints which connect the ends of the levers with the universal joints at the ends of the fuel discharge pipes; 31 toggle levers pivoted at their meeting ends upon a bolt 32 which is provided with a winged nut 33, as shown; 34, an operating handle pivoted upon the bolt 32 at the meeting end of the levers; 35, the pivotal joints which unite the outer levers to the channel bars 19 in any suitable way; and 36, the pivotal joints which unite the lower levers to the universal joints or connections at the ends of the fuel discharge pipes.

Any suitable type of blower and means for supplying fine fuel, such as pulverized coal, to the main blast pipe 6 may be employed and such blowers and means being well known in the art I have not illustrated or described the same.

The mode of operation is as follows: Assuming the fuel discharge pipes 4, 4, to be in the relative positions shown by Fig. 2 and powdered fuel mixed with air to be projected from the discharge pipes, the two currents or streams will meet at point or place A where the fuel and air will become thoroughly commingled and the two currents change directions and become united to form a single current extending in a substantially straight line B—B, when the fuel and air issue from the discharge pipes under like pressure. The fuel being ignited an intense heat is localized at the place A and for some distance inwardly therefrom, the length of the flame depending upon the amount of fuel discharged and the air pressure. By turning the damper 11 in the main blast pipe 6 so that more fuel and air under pressure will be delivered from one of the discharge pipes than from the other, the flame will be shifted from the place A to a position at one side of a vertical plane passing through the lines B—B. Obviously the flame can thus be shifted from side to side of the internal surface of the kiln as occasion may demand. To change the place A of the most intense heat to a position nearer the lower end of the kiln, as at C, the threaded shaft 24 is revolved, the toggle levers 28, 28 operated, and the discharge pipes 4, 4 moved apart at their free ends so the air and fuel delivered will meet at the place C.

To localize the flame and most intense heat inwardly at any place on the line B—B from the lower end of the kiln the free ends of the discharge pipes 4, 4, are moved towards each other by the toggle lever mechanism and the currents or streams of air and fuel thus caused to meet at the desired place. When the discharge pipes 4, 4, coincide in direction with the lines D—D the place of most intense heat will be located far within the kiln at the meeting point or place of the two streams or currents of air and fuel. As previously explained in connection with the place A, the flame may be shifted from side to side of the internal surface of the kiln from the point or place wherever in the plane of the line B—B the two currents of fuel and air may be caused to unite or meet. By the manipulation of the toggle levers 31, 31, the free ends of the discharge



pipes may be moved so that the common flame will be localized at the top internal surface or bottom internal surface of the kiln, near the lower end of the kiln, as indicated by the dotted lines E and F, or it may be localized at the top and bottom internal surfaces at places some distance within the kiln.

It will be observed that each discharge pipe 4 forms at one end with the surface bounding the smaller opening in a truncated cone casting a swivel joint, or universal joint, and that the opposite end can be moved through practically the circumference of a circle so that the current of fuel and air may be directed towards any portion of the internal surface of the kiln or axially thereof. Under some conditions it may be desirable to use a single discharge pipe thus swiveled at one end in the wall of the hood, but two such pipes are preferably employed and the currents of fuel and air or flames united to form one current or flame inasmuch as by bringing the currents of fuel and air together the same are more thoroughly mixed and more complete combustion with a greater heat results. Again, by bringing the two flames or currents of air and fuel together at an angle the heat may be localized near the lower end of the kiln and in this and other locations there is less tendency for the flame and heat to swiftly pass through the kiln to the stack before the heat has been transmitted to the material under treatment.

A NEW LUBRICATOR FOR CEMENT MILLS.

We are in receipt of a booklet from the C. J. Van Doren Company, 5 West Madison street, Chicago, describing the Van Doren lubricator. This lubricator is of the spring feed type and is dust proof. The exclusion of grit and dust from the bearing by a dust-proof lubricator eliminates a large part of the wear on the babbitt and also effects saving in lubricant. The Van Doren is pointed out to embody the most important features necessary to lubricating economy. A blueprint in the booklet shows the detailed construction and explains the installation of the Van Doren lubricator. Mr. Van Doren, the inventor, is now superintendent of the Ash Grove Cement plant at Chanute, Kans.

The Superior Portland Cement Company, will remove the executive offices from Charleston, W. Va., to Cincinnati, O., and will occupy handsomely furnished rooms on the fifteenth floor of the Union Trust Building.

A large delegation of the officers and stockholders of the Crescent Portland Cement Company left Pittsburg the other day to attend the annual meeting of the company at Wampum, Pa., about fifty miles from this city. The meeting was held at the offices at the new plant which is being built, and which is rapidly nearing completion. The election by the stockholders resulted in the selection of the following board of directors: W. J. Prentice, George W. Hackett, David M. Kirk, A. C. Smith and Jacob Friday, all of Pittsburg; R. H. Hughes and John Wallace, of New Castle, Pa., and C. M. Hughes and J. Sharp Wilson, of Beaver, Pa. The board of directors then elected W. J. Prentice, president; R. H. Hughes, vice-president and general manager; C. M. Hughes, treasurer; J. Sharp Wilson, assistant treasurer and R. H. Hughes, secretary.

After the election a luncheon was served at the plant, and in the afternoon a complete tour of inspection was made to note the progress being made. The plant is nearly all under roof, and in several of the buildings much of the machinery has been installed, although there is much to do yet.

The Southwestern Portland Cement Company, El Paso, Tex., announces that its mill will be completed by June 1. It will have a capacity of 1,200 barrels per day.

THE NORTHWESTERN CEMENT PRODUCTS ASSOCIATION.

The Fifth Annual Convention of the N. W. Cement Product Association will be held at the Armory at Minneapolis, Minn., on March 2nd, 3rd and 4th. This is always one of the best cement shows in the country, with a large attendance of people who are engaged in cement construction, the display of machinery and cement products are always up to date. The management is in strong practical hands entirely free from red tape and burdensome restrictions. The membership is large. It represents one of the prosperous and progressive centers of cement consumption.

The Interstate Cement Tile Mfg. Association will meet and conduct their proceedings in connection with the N. W. Cement Products Association show. A large line of exhibits of machinery and cement product manufactures have secured space at the Armory.

These exhibits will be up to date showing the progress and improvements made in cement construction machinery during the year.

The membership of the association represents more than $1,000,000 in machinery, plant and equipment spread throughout the Northwest. For space or other information connected with the association, address Martin T. Roche, Pres., Pioneer Press Bldg., St. Paul, Minn., or J. C. Van Doorn, Minneapolis, Minn. Remember the date, March 2, 3 and 4th at Minneapolis, Minn.

The Atlas Portland Cement Company is reported to have purchased the Hudson Portland Cement Plant and real estate holdings at Hudson, N. Y. and the Glens Falls Portland Cement plant at Glens Falls, New York.

The Elwood City Water Company, general offices at Elwood City, Pa., announces this week that steps will be taken at once toward the construction of the proposed new filtration plant for that city. The plans for this work were prepared last summer, but the financial conditions were so bad that it was finally decided to postpone the building of this plant until the summer of this year. There will be some few changes made in the plans that were prepared and accepted, and bids will then be asked for, which will probably be about the middle of February or the first of March. The plant will be located but a short distance from Elwood City, and will call for a considerable amount of concrete construction.

Bates & Rogers, 355 Dearborn st., Chicago, Ill., have been awarded a contract for the construction of a dam and power plant on the Prestigo River at Ellis Junction, Wis. The work is to be done for the Northern Hydro-Electric Power Development Company and will involve the expenditure of $500,000. The dams are to be constructed of earth and concrete.

The Riverside Sand and Cement Manufacturing Co., Roswell, N. M., has been organized with $50,000 capital to deal in sand, gypsum and cement lands.

A company has been organized in Los Angeles, Cal., to manufacture concrete railroad ties. Elijah D. McDonald is the inventor of the system by which they are to be made. The special feature of the ties is that the spikes are driven into iron sleeves fixed in the body of the tie. The company estimates that the use of its concrete ties will save $1.10 per tie per year, or about $2,000 per mile.

THE PRESENT AND FUTURE OF THE CEMENT BLOCK.

Its Manufacture, Its Availability, Its Cost.

Cement blocks are destined to play the important part in all forms of construction work in the future. Concrete construction is here to stay. It has every virtue possessed by any other building material, and possesses some not possessed by any other. When we look back and see the development of the cement block; note the difficulties through which it has passed; consider the mistakes that have been made both in its manufacture and exploitation; it is a wonder it has survived, and it would not have survived had it not inherently, the virtues it possesses.

I need not call your attention to the dark period of the past; you are all familiar with the history of this material; how it was first molded in sand, then in wood forms, then in iron forms, then came the machine for manufacturing them, then a period of strong effort to have them used in construction work with indifferent success, then a period of constant pioneering, and finally the invention of a simpler machine for producing them that opened the way for a flood of entrants into the business.

With the flood came many incompetents, and with the flood also, there arose, like mushrooms in the night, a rush of machine manufacturers whose strongest desire was, in many cases, to get a piece of the good thing that was going around, regardless of the past, present or future of the business.

Designs were furnished which produced blocks of the rankest artificiality in rock designs, the blocks were in many cases untrue in measurements, preposterous so far as the ventilation of the block was concerned, from a structural standpoint, and, because of the lack of business training or business instincts of many who entered the business, the blocks turned out were porous, imperfectly made, an eyesore and a detriment to the business.

I need not dwell upon the dark side of the picture too long, however, for there is a bright side, an encouraging side, a side of splendid promise in the cement block industry. My message to you today, therefore, is one of encouragement, and I desire to point out to you the tremendous advance cement blocks have made, and this will be the theme of this paper.

In every great business, we find a first period of enthusiastic effort, then the lull which comes, and then the conservative, painstaking, upbuilding era which ensues, and which means the development of the business on fundamentally correct lines.

Since the unpromising beginning which I have just related, perhaps it is necessary to show the development of concrete blocks from that beginning. In the first place, as I have said, many machines fell in the hands of incompetent people, people who had no experience whatever with concrete, knew nothing whatever of the selection of aggregates, mixing of the material, or curing of the stone, and they, therefore, found the easiest way to turn out blocks was to make them dry tamped. They added too little water to properly crystallize the cement. The development of the manufacture of good concrete stone in this regard has been marked and pleasing, until now instead of dry tamped blocks, they are tamped wet, just as much water being added as will permit the block to be removed from the machine without sagging or sticking. I, therefore, desire to say that it is essentially necessary for the proper manufacture of good cement blocks to select your aggregates with great care. You should use that proportion of sand and gravel which will secure the least possible voids. Then, proper mixing is essential. If hand mixed, the mass should be turned over at least three times in a dry state, and at least three times in a wet state, after the water has been added. You will find also if you use an ordinary rake as a last means of mixing your concrete, both in a dry and in a wet state, this will help the mixing of the materials very much. I need not say that this should be done after the mass has been turned at least twice with a shovel.

I want to lay particular stress upon the use of the proper kind of water and the necessity for measuring the amount of water used in making cement blocks. It is the writer's experience in several cases where blocks of different colors and shades were produced, using identically the same material, the same cement, and the same water, it was found that this change of color was caused by the water used. Tanks were erected for settling purposes, and then the cleared water used in the manufacture of the blocks, with the result, that this discoloration or change of color, disappeared entirely.

With regard to the use of the proper amount of water, the question as to which is the better, the wet or the dry mixing of concrete, has been much discussed, and recently in Germany there were given out the results of extended experiments covering some four years. From these reports the conclusion is drawn that the smallest amount of water which produces a mixing suitable for ramming, gives the strongest concrete. The results of these experiments confirm that which other experiments covering shorter periods of time indicated, and will not occasion any surprise. At the same time, the concrete worker who attempts to use the smallest amount of water which will produce a mixture suitable for ramming, will find many practical difficulties. There is, therefore, but one thing to do, viz. measure the water as well as the other aggregates for each batch mixed.

The proper curing of blocks after they are made is, of course, essential, indeed it is very essential, but it only plays its part in the whole process of manufacture. The possibilities of the cement block business have been too greatly underestimated until the last few years, and even now there are large fields still open. A few years ago concrete blocks were used for little less than foundations and cellars. The blocks of those days were usually of rock design, and as we have pointed out, the very worst rock effect at that. It seems strange upon consideration of this part of the business that that design was chosen for the most general exploitation of cement blocks which represented in the highest degree the artificial character of the product, and at the same time was the most difficult to closely imitate. There is no dressed stone design that varies so greatly as the rock, or quarry, faced stone, and there is no dressed natural stone so cheap as this design, therefore, in selecting this one for exploitation of cement blocks, the extraordinary and peculiar fact was brought home to us all that it required a greater variety of face plates and required also greater care in manufacture and use of this design to produce a pleasing effect than with any other that could be secured.

"Every cloud has its silver lining," however, and I believe the present is showing, and the future will still more show, the extraordinary development of this material. Go where you like, East, West, North or South, everywhere, you will find evidences that concrete blocks have come to stay. You will find foundations, houses, schools, churches, public buildings, factories, and even complete manufacturing plants constructed with cement blocks. Good concrete blocks are now being sold at a figure where they compete with common brick, and where pressed brick or cut stone was formerly used, concrete blocks have now an ever enlarging field. This is but as it should be, for as I have before pointed out, there is no virtue in any other building material not possessed by cement blocks, to which may be added the fact that they can be produced in as high a grade as any other material from an architectural

and structural point of view, at a cost lower than any other building material except lumber. Lumber is becoming scarcer and more expensive, and as a consequence, people everywhere are looking for another building material, and right here the concrete block steps in and claims its own. Its plastic character makes it possible to produce it in any desirable design. Its remarkable resistance to fire has been thoroughly attested, and in a few more years we will see concrete blocks used as commonly as brick is now, and that means that blocks will be used in the construction of the great majority of buildings.

Of all forms in which concrete can be used, I desire to specifically state that the cement block represents the most approved method. WHY? Because it eliminates to the largest extent possible, the human equation, in making concrete; because *a cement block is a unit that can be inspected before it goes in the building,* and therefore, its stability and perfection can be assured; because it represents the use of a *ventilated wall,* and this fact is a *distinct advantage in construction.* Furthermore, *this ventilation saves material and permits the installation of wires and pipes* within the walls of the building itself, and further, the block when delivered on the job is finished in design and needs no further dressing of the exterior surfaces.

Designs are now produced for cement blocks which make it possible to meet every demand of the architect for beauty of design. One of the most promising developments in the use of cement blocks, has been shown lately, in their use in conjunction with reinforced concrete columns, beams and girders. Many buildings have lately been constructed of reinforced interior, with concrete blocks for the exterior walls and partitions.

The materials most commonly used in concrete block manufacture, are, sand, gravel, or crushed stone, and Portland Cement. A lengthy paper could be written on sands alone, so that I will touch upon this subject but very briefly. The term sand is confused by a great majority of block manufacturers. In concrete work, sand is termed as that material which will pass a quarter-inch screen, and a good sand should be graded from coarse to fine, with the coarser grains predominating over the finer ones. A sand which is well graded from coarse to fine, is the one which will make the strongest concrete, and such sand, makes the densest concrete. The strength of concrete varies directly with its density. This is a well known fact, and one about which much has been written, so I will pass it by at this time without further comment.

Let me lay down this fact, however, and call your particular attention to it, *that no concrete can be stronger than the materials from which it is made.* Many block manufacturers insist on using for facings a very fine sand in mixtures of 1 to 2, not realizing that a coarse, well graded sand, will give them as strong a facing with a 1 to 3 mixture and a block of as good appearance as well. They make the excuse that they must use a fine sand in order to get a smooth block. When the tamping is directly against the face, as in most machines, the finer particles work themselves through the coarser ones into the face, and thus the surface is just as smooth as though a fine sand were used. Therefore, just as good a surface can be obtained by using coarse, well graded sand, and such a surface will be far stronger and more waterproof. The reason for this is, that in a fine sand the grains are nearly all uniform in size, and the percentage of voids will be between 40 and 50%, whereas, in a well graded sand they may be as low as 25%, consequently when using the same amount of cement with both sands, the coarser sand will make a denser, stronger and more waterproof concrete.

Another reason is, that for a given volume, the fine sand will have a greater number of particles, and consequently there is more surface to be coated with the cement mortar than in the case of the coarser sand. This means that more cement is required.

I desire again to touch upon the question of mixing the aggregates in the manufacture of blocks, and I wish to say, that it is very important to mix your aggregates with a mixing machine of a good type. You should be sure, of course, that the machine by its operation performs its work correctly, and coats the aggregate properly, in the process of mixing.

The subject of facing cement blocks is one which well deserves attention. Blocks are usually sold because of their good appearance and satisfactory qualities, and the man who faces his blocks with material which gives them life, is the one who gets the business.

One of the serious objections to concrete blocks in the past is their dark gray appearance. This can be overcome by using light colored sand, or crushed stone, and a white Portland Cement, which will give a light gray effect. If a pure white effect is desired, then white cement should be used, with white sand, or crushed stone, mixed with a little marble dust. It is very difficult to obtain a coarse white sand, although I have seen a few samples which were quite coarse. A fine white sand used alone with cement, will not make a thoroughly waterproof facing. In order to make such facing, waterproof, I have found it necessary to use a proportion of marble dust, or crushed stone, with the sand.

Care must be taken not to use too much marble dust, for if too much of this is used, the facing will check and show unsightly cracks. For this reason, marble dust should never be used alone with cement. Usually, the checks and hair cracks referred to, will not show until the blocks have aged several weeks, and even months, but eventually they are bound to come.

The amount of marble dust to be used, should not be more than 1½ parts of marble dust to 4 parts of white sand. If the facing is too rich in cement, checks and hair cracks are liable to appear as when marble dust is alone used with cement. Very good results can be obtained by using limestone screenings, from coarse to fine, which will pass a quarter-inch screen, but usually, it is advantageous to use a little white sand with this as well, in order to produce a smooth, dense surface.

This brings us up to the proportions which should be used to produce maximum strength in cement blocks. The specifications of this Association require a minimum crushing strength of 1,000 lbs. per square inch of superficial area at the age of 28 days. They further call for proportions of 1 part cement, 3 sand, 4 gravel. Where a good coarse sand is obtainable it is sometimes more economical to use sand only in the proportion of 1 part cement to 4 parts of sand, pit run. If the sand is coarse, and well graded, such blocks will develop over 1,000 lbs. per square inch in 28 days.

I call attention to this part of the specifications of the Association because it has been found in actual practice that it is frequently not possible to get good gravel, while good sharp sand can be found in quantities. I therefore call your attention to the comparative cost of blocks when using proportions of 1 part of cement to 4 parts of sand, pit run, when same is a good coarse grade, as against 1 part of cement, 3 part of sand and 4 parts of gravel, when sand and gravel have to be screened. The cost is then considerably higher than the ordinary sand. As for instance:—

100 8x8x16 inch blocks, in the proportion of 1 part of cement will require:—

1 41-100 yds. of sand at.....	$ .60	$ .85
2 63-100 bbls. " cement at...	1.50	3.95
Total		$4.80

100 of the same blocks, when made

1, 3, 4, and with a facing 1, 2, will require:—

1 5-100 yds. of gravel at....	$1.00	$1.05
79-100 " " sand "	1.00	.79
2 2-100 bbls. of cement at...	1.50	3.03
Total		$4.87

Therefore, you will see, in such cases as the above, where the price of cement, sand and gravel is considerably higher than that of pit run sand of a good coarse character, it is more economical to use 1 part of cement to 4 parts of sand, as the materials in this will cost less, and the labor of mixing will also be less.

It has always seemed to me that it is most important to get the requisite strength regardless of proportions, and if a 1—4 sand concrete will give these results, I say, use a 1—4 mixture. The same holds true of a 1—3—6 mixture, providing it will give the required strength. Proportions of 1—2—4, 1—3—4, 1—2½—5, and 1—2—5, should all prove rich enough in cement to make blocks which will develop a crushing strength of 1,000 lbs. per square inch at 28 days. I, therefore, think our specifications ought to allow the use of any proportions that will meet the strength requirement.

This brings us up to the subject of curing. Wet tamped blocks should be sprinkled two or three times daily for a period of 2—3 weeks. They should be sprinkled after molding as soon as the concrete has obtained its initial set, which it will do in from 12 to 24 hours.

The temperature of a curing room should range from, say, 80 to 180 degrees Fahr., provided the blocks are kept sufficiently wet.

The temperature of the curing room should never be lower than the freezing point of water, for if carried below this point, the blocks will freeze, and even though they be not injured, the setting of the cement will be delayed; in fact the blocks will be no stronger at the time they thaw out than when they first froze, for the process of hardening stops at the time of freezing and does not resume until the blocks are thawed out. Many manufacturers will use blocks a few days after they are made, but this is a great mistake, and should never be allowed, as blocks cured by the sprinkling method for a few days are not strong enough to build in structures, and it is just work of this kind that discredits the use of this material. Every now and then one can see blocks that are so crumbly that the surface can be cut away, and this, almost invariably, is caused by insufficient water in the mixing, or inefficient curing. It sometimes is caused by not using enough cement, but the former reasons are more often the case.

Another point I wish to emphasize is the fact that no amount of subsequent sprinkling will make up for an inadequate amount of water in the mixing of the concrete, that is to say, if a man uses but half as much water in his concrete as he ought for a good block, no amount of subsequent sprinkling will make that block what it should be.

This is one subject that has had the earnest attention of many people. As I have before stated, good, dense concrete, absolutely waterproof and impervious to moisture, can be made by the proper selection of aggregates, the proper mixing of the materials, the addition of a sufficient amount of water and proper curing of the stone. This is particularly true where you can use a rich facing mixture for the block, but to make assurance doubly sure, there has been devised, Waterproofing Compounds and Waterproofing Fillers to make the blocks dense and impervious to moisture.

I believe the Government is conducting a series of tests at the Testing Laboratories at St. Louis, which will be given the Association shortly, and this result will, of course, clearly demonstrate the effectiveness of such methods.

I now come to the subject of cost data on cement blocks, and I have prepared this data, showing the comparative costs of cement blocks and common brick laid in the wall. In drawing up this table of costs, however, I have used faced blocks entirely throughout my computation, and have compared faced blocks with common brick in the figures given.

I have also prepared a comparative statement of faced cement blocks and facing brick in conjunction with ordinary brick laid in the wall, as well as a comparative cost of cement blocks and monolithic construction. In getting up this table I have had an eye to the absolute conservatism that should surround such a table in figuring such costs, and I think you will find that I have tried to treat this subject in a thoroughly conservative way. If I have erred at all, it has been in placing the cost of blocks too high, and the cost of brick too low, but I have done this with the idea of being ultra conservative so far as blocks are concerned. Furthermore, I have made a distinction in this cost data, as between the small sized plant, operating with two or three men, mixing by hand, and buying materials in small quantities; and, the thoroughly and perfectly equipped plant where the materials are elevated, pneumatic or power tamping used, materials bought in quantity, cars and track used for the transportation of the blocks turned out per day. A well thought out, complete plant, properly equipped, will, of course, reduce the cost of the stone turned out materially.

I, therefore, beg to call your attention to the following cost data as above outlined,—

Proportions of 1—3—4.

Facing ½" thick of 1 cement—2 sand.

100—8x8x16" Blocks require:—

100—8x8x16" Blocks require:—		
1.05 yds. Gravel, at..	$1.00	$1.05
.79 yds. Sand, at....	1.00	.79
2.02 bbls. Cement, at	1.50	3.04
Labor, at .....02¾c pr blk		2.75
		$7.63
100—8x10x16" Blocks require:—		
1.40 yds. Gravel, at..	$1.00	$1.40
1.06 " Sand, at.....	1.00	1.06
2.62 bbls. Cement, at.	1.50	3.94
Labor, ... 03c per blk		3.00
		$9.40
100—8x12x16" Blocks require: —		
1.68 yds. Gravel, at..	$1.00	$1.68
1.27 " Sand, at....	1.00	1.27
3.08 bbls. Cement, at.	1.50	4.62
Labor, at .... .03¼c per blk		3.25
		$10.82
100—8x8x24" Blocks require:—		
1.62 yds. Gravel, at..	$1.00	$1.62
1.23 " Sand, at....	1.00	1.23
3.12 bbls Cement, at..	1.50	4.68
Labor, at .....04c per blk		4.00
		$11.53
100—8x10x24" Blocks require:—		
2.02 yds. Gravel, at..	$1.00	$2.02
1.53 " Sand, at....	1.00	1.53
3.80 bbls. Cement, at.	1.50	5.70
Labor, at ..... .04¼c pr blk		4.25
		$13.50
100—8x12x24" Blocks require:—		
2.43 yds. Gravel, at..	$1.00	$2.43
1.82 " Sand, at....	1.00	1.82
4.46 bbls. Cement, at	1.50	6.70
Labor, at ..... .04½c pr blk		4.50
Total cost of 100 blocks, ...		$15.45

A high grade of facing brick costing $21.00 per thousand, will cost, laid in the wall, $48.00 per thousand, We have assumed common brick at $14.00 per thousand.

An 8 inch brick wall faced with pressed brick as per the above, and equivalent to 100—8x8x16 inch blocks will require:—

100—8x8x16" Blocks will displace from 1333 to 1422 Brick.	
1333 Brick laid in wall at $14.00 per M., cost	$18.67
100—8x8x16" faced Blocks cost..$7.63	
These selling at 4c profit per Block, cost	$11.63
Laying in walls costs, ...	3.00
	$14.63 $14.63
Saving on every 100 Blocks, ...	$ 4.04
100—8x12x16" Blocks will displace from 2000 to 2133 Brick.	
2000 Brick laid in wall at $14.00 per M., costs, ...	$28.00
100—8x12x16" faced Block cost, $10.82	
Allowing 4c profit per Block, cost, ...	$14.82
Laying costs, ...	4.00
Total cost in wall, ...	$18.82
Saving on every 100 Blocks, ...	$ 9.18
100—8x8x24" Blocks will displace from 2000 to 2133 Brick.	
2000 Brick laid in wall at $14.00 per M., ...	$28.00
100—8x8x24" Blocks cost $11.53	
Allowing 5c profit per Block cost, ...	$16.53
Laying costs, ...	5.00
Total cost in wall, ...	$21.53
Saving on every 100 Blocks, ...	$ 6.47
100—8x12x24" Blcks will displace from 3000 to 3200 Brick.	
3000 Brick laid in wall at $14.00 per M., cost	$42.00
100—8x12x24" Blocks cost $15.50	

Allowing 6c profit per block cost, ...$21.50
Laying at 7c per block, ... 7.00

Total cost in wall, ...$28.50

Saving on every 100 Bricks, ...$13.50
667 Pressed Brick at $48.00 per M., ...$32.00
667 Common Brick at $14.00 per M., ... 9.33

TOTAL $41.33
100—8x8x16" inch faced blocks laid in the wall costs.....$12.93

Saving on every 100 blocks,.$28.40

A 12 inch brick wall, faced as above, and equivalent to 100—8x12x 16 inch blocks will require:—

667 Pressed Brick at $48.00 per M., ...$32.00
1333 Common Brick at $14.00 per M., ... 18.66

TOTAL $50.66
100—8x12x16" Blocks laid in the wall costs, ... 16.55

Saving on every 100 Blocks $34.11

The above figures allow 4c profit per block to the manufacturer. In a case like this the manufacturer would figure on a higher profit, as he is alays sure of getting the job when competing with pressed brick.

An 8" brick wall, faced with pressed brick and equivalent to 100—8x8x24" Blocks will require:—

1000 Pressed Brick at $48.00 per M., ...$48.00
1000 Common Brick at $14.00 per M., ... 14.00

TOTAL $62.00
100—8x8x24" Blocks laid in the wall cost, ... 19.00

Saving on every 100 Blocks, ...$43.00

These figures allow the manufacturer 5c profit per block.

A12" Brick wall faced with pressed brick, and equivalent to 100—8x12x 24" Blocks will require:—

1000 Pressed Brick at $48.00 per M., ...$48.00
2000 Common Brick at $14.00 per M., ... 28.00

TOTAL $76.00
100—8x12x24" Blocks laid in the wall cost, ... 27.65

Saving on every 100 Blocks, ...$48.35

The above figures allow 7c per block, profit, to the amnufacturer.

As stated above, when competing with pressed brick and cut stone, the manufacturer will usually charge a higher price for his blocks, as he will have a greater leeway.

The above computation on brick is figured upon the least displacement 100 blocks will displace in the wall. 1333 brick is figured on a basis of 22½ brick to the square foot of 12" wall, three brick thick, or, 15 brick per square foot of 8" wall. The same is true in every other computation I have made, as I have taken the least displacement possible on which to base my figures so that the results can not be questioned from a standpoint of favoritism to cement blocks. Furthermore, all the above is based on costs shown in small sized plants, operating with two to three men, mixing by hand, and buying materials in small quantities.

The labor costs include all fractional and widow jamb blocks. Furthermore, the costs shown are on faced cement blocks against common brick. Where pneumatic, or power tamping, is used, materials are bought in quantity and a greater number of block turned out, the cost can be cut down considerably, and will more nearly approach the following:—

100—8x8x16" Blocks will require:—
1.05 yds. Gravel, at..$ .80 8 .84
.79 " Sand, at.... .80 .63
2.02 bbls. Cement, at. 1.30 2.63

Labor $5.93

This assumes a reduction in labor of 33 1/3%. Figuring on the above basis the other sizes will cost as follows:—

100—8x10x16" faced blocks will cost $ 7.46
100—8x12x16" faced blacks will cost 8.55
100—8x8x24" faced blocks will cost 9.00
100—8x10x24" faced blocks will cost 10.63
100—8x12x24" faced blocks will cost 12.21
100—8x8x16" Blocks, with 4c profit per block, can sell at .....$ 9.93
Laying in wall will cost, ... 3.00

$12.93

Equivalent Brick (1333) laid in wall at $14.00 per M., ...$18.60

Saving on every 100 Blocks, ...$ 5.67
100—8x12x16" Blocks, with 4c profit cost, ...$12.55
Laying costs, ... 4.00

$16.55

Equivalent Brick (2000) laid in wall at $14.00 per M., ...$28.00

Saving on every 100 Blocks, ...$11.45
100—8x8x24" Blocks, with 5c profit per block cost. $14.00
Laying costs, ... 5.00

Total cost in wall, ...$19.00
Equivalent Brick (2000) laid in wall at $14.00 per M., ...$28.00

Savings on every 100 Blocks 9.00
100—8x12x24" Blocks, with 7c profit per block costs, ...$20.65
Laying costs, ... 7.00

Total cost 100 blocks in wall,.$27.65
Equivalent Brick (3000) laid in wall at $14.00 per M., ...$42.00

Savings on every 100 Blocks, ...$14.35

An 8" Monolithic wall, 1—3—5, figured on a basis of $1.00 per cu. yd. for gravel and sand, and $1.50 per barrel of cement, will cost about $7.12 per cu. yd. under very fair conditions.

100—8x8x16" Faced Blocks cost, ...$5.93
Laying costs, ... 3.00

Cost in wall, ...$8.93
Cost per cu. yd., ... 4.09
Saving per cu. yd. in favor of blocks,.3.03
A 10" Monolithic wall will cost $6.52 per cu. yd.
100—8x10x16" Faced Blocks cost, ..$ 7.46
Laying costs, ... 3.50

Cost in the wall, ...$10.96
Cost per cu. yd., ... 3.99
Saving per cu. yd. in favor of blocks, ... 2.53
A Monolithic 12" wall will cost $5.02 per cu. yd.
100—8x12x16" Faced Blocks cost, ..$ 8.55
Laying costs, ... 4.00

Cost in the wall, ... 12.55
Cost per cu. yd. of wall, ...$ 3.82
Saving per cu. yd. in favor of blocks, 1.20
100—8x8x24" Faced Blocks cost, ...$ 9.00
Laying costs, ... 5.00

Cost in the wall, ...$14.00
Cost per cu. yd. of wall, ...$ 4.27
Saving per cu. yd. in favor of blocks, 2.85
100—8x10x24" Faced Blacks cost,..$10.63
Laying costs, ... 6.00

Cost in wall, ...$16.63

Cost per cu. yd. of wall, ... 4.05
Saving per cu. yd. favor of blacks, 2.47
100—8x12x24" Faced Blocks cost, ..$12.21
Laying costs, ... 7.00

Cost in the wall, ...$19.21
Cost per cu. yd. of wall, ...$ 3.89
Saving per cu. yd. in favor of blocks, 1.13

I desire to call your attention to the fact that the above figures are based, in the one case, on cement blocks in a finished wall, while in the case of the Monolithic wall, the superficial surfaces still have to be taken care of, which adds, naturally, to the cost, and which is not included in the above figures. These figures, therefore, show how much cheaper concrete block walls are than the solid monolithic walls, and the above figures are on the plainest kind of monolithic work, and do not take into account any reinforcing.

The cost of white cement for white facing, is nearly 2¼c per block, 8x 8x16", and should be figured at 3⅜c per block 8x8x24", on the basis of $5.00 per barrel for white cement.

White sand will cost about 1c for the 16" blocks and 1½c for the 24" blocks. This is figured on a facing of 1 cement to 2 sand, facing to be ½" thick.

Before I leave the subject of costs in cement block construction, I desire to call particular attention to the antagonism to the use of concrete blocks by bricklayers and masons generally. It is a conceded fact, I believe, that cement blocks can be laid in the wall nearly one-half as fast again as the same number of brick. There is undoubtedly a distinct and determined effort on the part of bricklayers and masons to prevent the use of cement blocks wherever it is possible to discard them, and this Association should take this matter in hand and endeavor to have passed a regulating scale for the laying of cement blocks, that would permit equitable and fair treatment. The bricklayer is paid by the hour, and it seems to me, it should not matter to him whether he lays blocks or brick. But he does,—and I am constrained to believe that the genesis of the bricklayers objection lies in the brick manufacturer, who exerts his antagonism through the tentacles of the Bricklayers Union, or Association.

I may say from personal knowledge, that it is a difficult matter to have cement blocks laid in many cities; they won't touch them. They frequently excuse themselves on the ground that it cuts down their wages. This explanation is, however, futile, in view of the fact that these workmen are paid by the hour, irrespective of the number of blocks, or brick, laid, and I think the time is propitious for taking up this subject in an intelligent, aggressive way, and arranging this matter upon a basis that shall

e fair alike to the employer and the mployed.

The submission of the figures I ave quoted above, and the showing n reduced costs of the complete, horoughly equipped plant, brings up he question of the proper equipment, f a complete and up-to-date plant, nd the profit to be made by conduct- roperly equipped, is a very profit- ble one indeed. As a matter of fact, know of no business to-day in which man can engage with such assur- nce of success, and with so small an ıvestment to begin with, as in the ement block business.

I desire to call your attention, how- ver, to the fact that it is just as nec- ssary to exercise good judgment and ommon sense in the conduct of this usiness, as it is in any other. As a natter of fact, the great lack of or- inary business judgment, and or- inary business method, has been one f the great causes in the past for any of the failures which have taken ace.

A good, complete plant should be ell laid out, with sufficient buildings nd sufficient yard room in which to nduct the business satisfactorily nd economically. Elevators should used to elevate the materials above e mixing machines; mixers are es- ntially necessary; power tampers ould be installed, and I believe, the ture will demonstrate that cement ocks should be cured by high essure steam. I believe the tests hich were carried out at St. Louis, nd which have been conducted for me time past, have conclusively oven that there is a method of eam curing, under pressure, that is fe and sound, and that this method oduces results that are really aston- ning.

I, therefore, wish to say, in closing is paper, that the future for cement ocks is most promising. Indeed, e use to which this material will be t will be of the widest character, d it is different to exaggerate the im- rtance of cement blocks in future nstruction work. Their manufac- e is a business in which great pro- can be made; it is a business which worthy of the highest craft and e, and if you will perform your are in turning out blocks of ac- otable design to the architect, blocks good appearance, well cured, and ich will be impervious to moisture, say to you, you will one day reap harvest you have worthily pre- red.—(Paper delivered by J. Au- stine Smith, Secretary, Ideal Con- te Machinery Co., South Bend, l., at Cement Users Convention, veland.)

A LINOLEUM WEARING SURFACE FOR CONCRETE FLOORS.

I have read in many papers descriptions of many fine concrete buildings, and in every case, in offices, the floors have been covered with hard wood, which introduces a large amount of combustible material in a building supposed to be fireproof.

I recently built a concrete extension to my factory (Tucker & Vinton, contractors) and, having no external fire risk and the goods manufactured being non-combustible, I decided to use as little wood as possible and carry no insurance.

The contractors recommended maple flooring for the office and I found that that material was commonly used elsewhere; but I would not have it. I had observed that good quality linoleum would wear better than wood, so I had the office floors troweled off smooth and decided to cement the linoleum directly to the cement surface.

None of the linoleum concerns would take the contract, as they said "the moisture in the concrete will loosen the cement"; but I did not agree with them, so I had the linoleum fitted to the different rooms and did the cementing with my own force.

After carefully fitting the material to the edges of the room, the men would roll it back from one-half the space, carefully sweep the floor and scrape off any unevenness. Then the cement surface was covered to a depth of about 1 1/16-in. with liquid fish glue thinned down slightly with hot water so that it would be worked with a large kalsomine brush. On many places the glue would be fully 1/8-in. deep and we have observed that there is little danger of applying too much.

After coating the surface with glue the linoleum was carefully rolled back into place and for a few minutes a dozen laborers would walk back and forth over it to ensure even contact. Then the operation would be repeated over the remaining half of the room. As soon as the covering was laid, the entire surface was covered with brick, sections of structural steel and other pieces of flat, heavy material and allowed to remain for several days.

It was found that the glue would quickly harden at the seams and edges, but remained moist elsewhere for several months. Nevertheless the atmospheric pressure was sufficient to prevent the slightest buckling at any point, even under constant use, and to-day, after over twelve months' hard service, we have an ideal floor surface.

The floor is almost as quiet as if covered with rubber, yet it has the feeling of wood and the firmness of cement. When wiped over occasionally with linseed oil and turpentine it remains perfectly waterproof.

The linoleum for the surface of about 4,000 sq. ft. cost $400 cut to fit the rooms. We used just 50 gallons of liquid glue at a total cost of $85. The labor amounted to about $95, including the carrying of the large amount of brick for weighting the surface. Thus the total cost was but 14½ cts. per sq. ft., probably less than half the cost of the average maple floor.

As our partitions are all of reinforced concrete 5 ins. thick poured in place, and the only woodwork is about the door openings, we consider our offices practically fireproof. Even if it were possible for the linoleum to burn off from the cold concrete surface, its calorific value is so small that it would not add appreciably to a fire.

Yours truly,
S. W. RUSHMORE,
629 South Ave., Plainfield, N. J.

The Marquette Cement Mfg. Co., is to increase its capital stock to $2,000,000, and its output to 6,000 barrels per day.

C. B. Blake is promoting a cement plant to be located at Weatherford, Oklahoma. The plant is to cost $500,000. Mr. Blake will give information regarding the enterprise. Address, Weatherford. Oklahoma.

THREE FORKS PORTLAND CEMENT CO.

D. A. Morrison, Supt. and Business Mgr., of the Three Forks Portland Cement Co., reports that 50 men are engaged on construction work on the plant, which is located a few miles from Three Forks, Gallatin Co., Montana, on the Northern Pacific Ry., C. S. Fisher, the company's engineer, in charge of construction work. Mr. Charles Betcher of Denver, O. B., Gilson of Ogden, and Charles Schrowcraft of Salt Lake City, are largely interested in the enterprise, while Butte, capitalists are the real financial backers of the company. The plant is to be finshed ready for operation before September 1st of the present year.

The U. S. Portland Cement Co., at its annual meeting at Cement, Colorado, elected the following officers: Adolph Coors, Pres.; Joseph D. Blunt, Vice Pres. and Gen. Manager. Directors chosen are, Adolph Coors, J. D. Blunt, W. H. Kelso, C. P. Allen, and H. W. Humphries. The annual report shows the company to be in an excellent financial condition.

WHEN AND HOW PILING SHOULD BE USED IN FOUNDATIONS.

When the soil is bad where a foundation is needed, it is often necessary to resort to the use of piling, set to a depth sufficient to reach solid support or to get a sufficient "grip" on the surrounding soil to support its superincumbent weight. In mushy soil and quicksand conditions, this is absolutely necessary, unless the piers are carried to hardpan or bed rock by means of caissons.

It may be found, that, even under the same building, the soil conditions will vary enough to make it necessary to use piling under some parts of the building, other portions of which are satisfactorily supported by the ordinary foundations. The distortion of a good many buildings already erected has been due to inattention to this very precaution. A careful study of soil conditions is therefore an important preliminary to the erection of any expensive structure.

Whatever piling is necessary it is important that it be of proper material, sufficient in amount, and well driven. Lacking in any one of these particulars, there is likely to be trouble some time in the future.

The amount of piling of course could not be indicated in any general statement, since it depends wholly upon the weight to be carried and the nature of the soil, conditions that must be studied for each particular case.

As for the setting, it is enough to point out that they should stand as nearly vertical as possible, so as to carry their load properly; and be arranged so as to correspond with the character of the foundation above it. In the case of pier foundations, the piles will naturally be nested in threes, fours, fives, or even greater numbers, as may be necessary. For supporting continuous walls it is desirable that the pile be "staggered," or arranged alternately in two parallel lines under the foundation footing or "caps."

The "capping" should perferably be of concrete, whether the piles support a pier or a wall. It is the most desirable material that can be used for this purpose.

It not only gives a firm and even support over all the piles, but ties them all together and if reinforced acts as a girder between the supporting piles. Furthermore it is cheaper than the iron or wood grillage used for the same purpose, neither of which is comparable with concrete in point of permanence.

In the construction of steel frame structures it is desirable that they be so designed that the weight will rest on isolated piers rather than on foundation walls. In such cases the nested piles support the weight of the building and its load, the weight of the walls being transferred to the columns or piers.

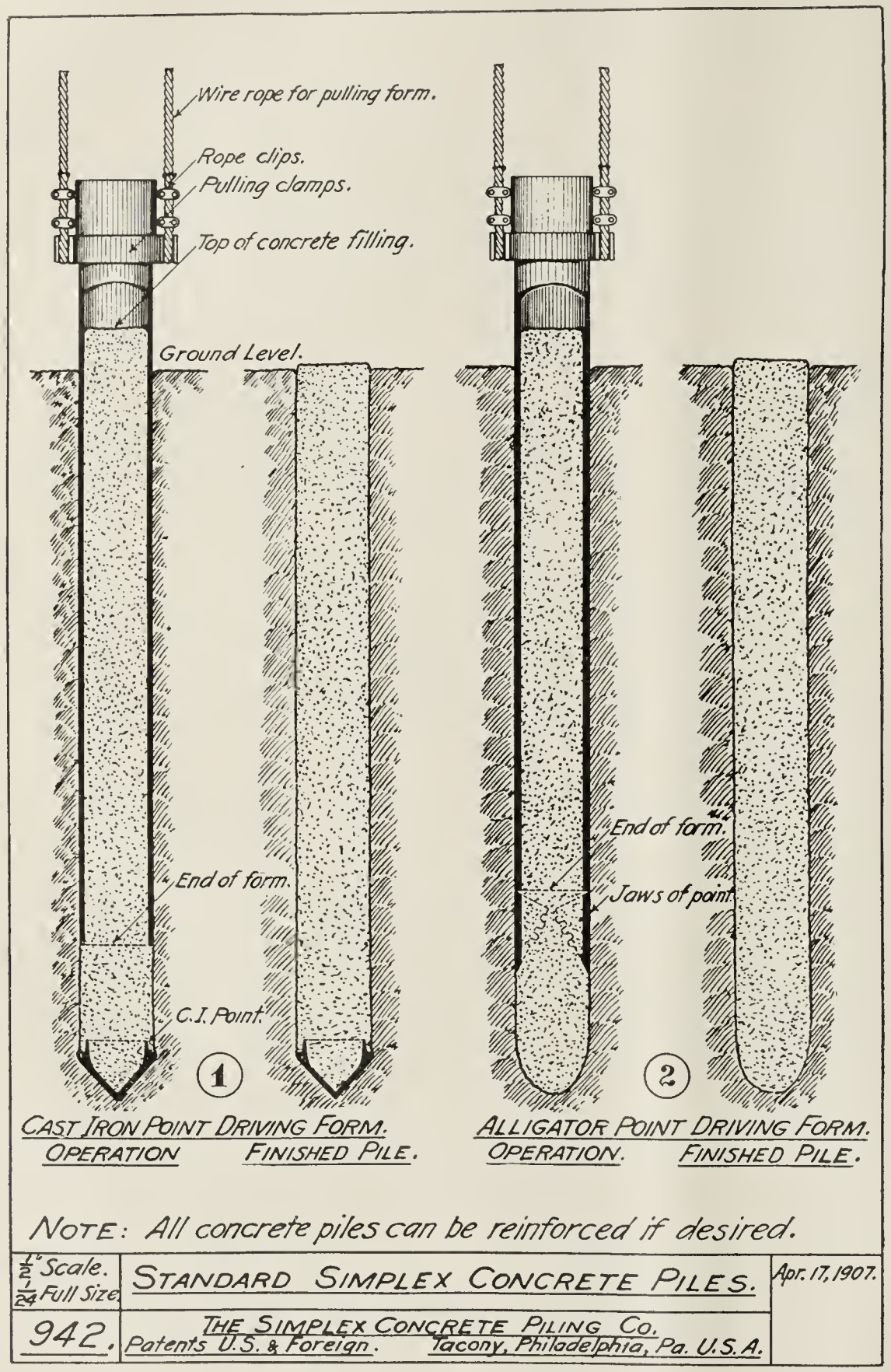
Concrete and wood are the only materials seriously to be considered for piling for general purposes. In a few cases steel tube piles are necessary, however, as for underpiling the walls or piers of old buildings to stop settlement, and in case it is necessary to drive them close to the walls of existing buildings.

Until recently wood was used almost exclusively, for the reason mainly that no other suitable material was thought to be at hand.

Wood piles are cheapest, in first cost; but there are many conditions under which they lack permanence.

Concrete piles are considerably more expensive than wood, but in view of their permanence and the almost absolute assurance that there will be no failure under load, when properly constructed, this item may well be disregarded.

There are some situations where wood piling should not be used at all. This is true where they would come in contact with sea water, where they would be alternately dry and wet in fresh water, and where there is any liability that deep draining will lower the level of the ground water. Wood piling is permanent only when driven in soil constantly permeated with fresh water. Even when used in such situations care must be taken that the tops of the piles are at least two feet below the low water level. Unless they are they will certainly decay, because subject to alternate wetting and drying and to atmospheric changes.



Of the two methods of sinking concrete piles now in common use, driving a sheet iron casing with a removable core and filling the shell with concrete (reinforced or not) upon the removal of the core and driving a complete reinforced pile previously cast and seasoned above ground, the former is preferable. It eliminates the danger of injury to the pile in driving, a constant source of uncertainty even when the greatest care is used. This method is also cheaper, chiefly for the reason that concrete piles for driving must be carefully and heavily reinforced, whereas those cast in casings usually need be of concrete only.

The first system of concrete piling to satisfactorily meet with practical tests in this country was demonstrated in April, 1901, by A. A. Raymond. Shortly afterwards the Raymond Concrete Pile Company was formed for the purpose of placing upon the market a pile produced by the same methods and an extended field was soon developed. In its essentials, the method which characterized the making of the first Raymond piles is retained in the Raymond system of making and placing concrete piles as now practiced. Even the most hasty consideration of the Raymond system makes it evident that certain features are distinctive and can be neither claimed for nor controlled by any other system of concrete piling.

Since Raymond piles are made in place it is impossible to describe them without outlining the steps of both making and placement.

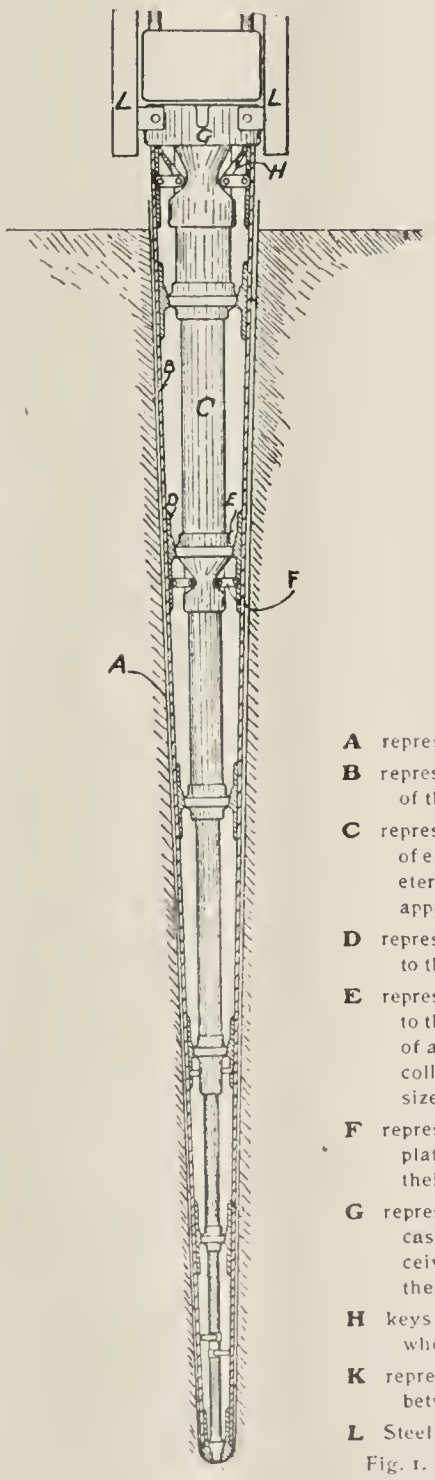
The fundamental principle of the Raymond system is "a shell or form for every pile"—a sheet steel form remaining permanently in the ground and protecting the pile during the entire process of filling and the setting of the concrete. This shell, composed of short cylindrical sections of sheet steel, superimposed, and with a steel shoe at the tip, constitutes the mold within which the concrete is to set and from which the pile takes its contour. It is of varying diameter, larger at the top and growing gradually smaller as the tip is approached, so that the pile is given a pronounced taper. It is claimed that this tapering shape distributes the load throughout the entire length of the pile and thus develops the maximum bearing capacity of the soil penetrated. In the straight pile, on the contrary, the load is largely concentrated upon the limited area at the point. Thus, where a pile penetrates the hard stratum lying near the surface into the softer, underlying material, the bearing value of the upper and more substantial stratum is fully taken advantage of by the large tapering wedge-shaped pile, while it would be nearly lost in the case of a pile which is straight or nearly so.

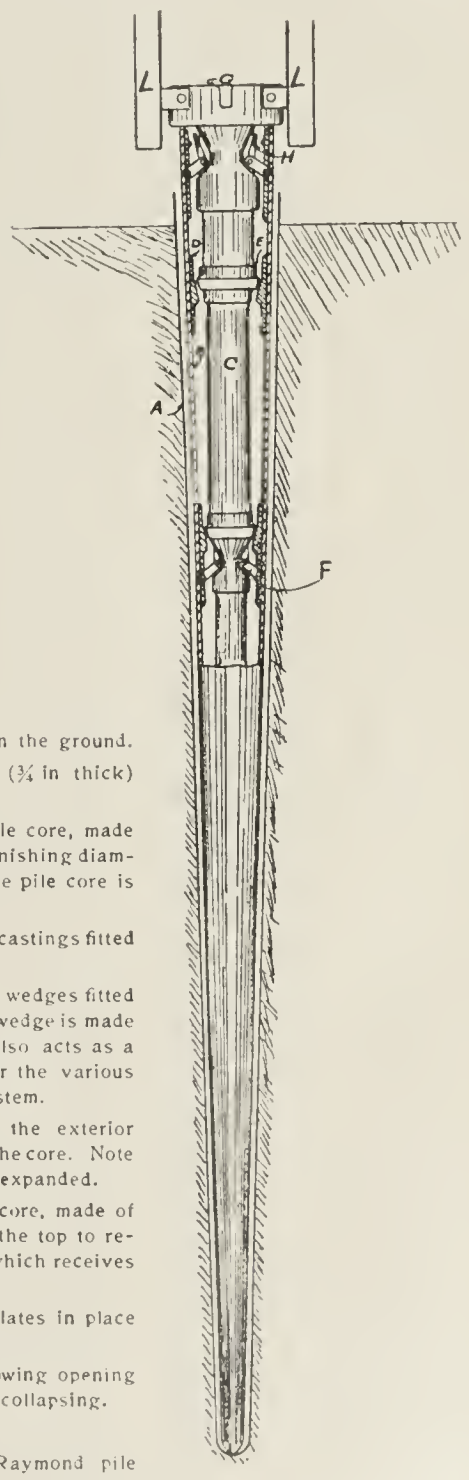
This point is fully borne out by comparing the results of tests made of straight and tapering piles in different parts of the country. In New York City, 25 ft. tapering piles were found to be equal to 40 ft. piles of uniform diameter. At Salem, Mass., 20 ft. piles, tapering from 20 inches at the top to 6 inches at the bottom, developed greater bearing value than 35 ft. piles with less taper and larger point. In New Orleans, 20 ft. piles of the size, just mentioned were found to be equal to 50 and 60 ft. wooden piles, which, while large, were nearly straight. At Boston, a pile 20 ft. in length, 20 inches at the top and 6 inches at the bottom, while it required a less total number of blows to drive, offered more final resistance than a 20 ft. pile of the same length, 18 inches at the top and 13 inches at the point.

The first step in the making and placing of a Raymond concrete pile is the making of the shell. This is done by bending two plates of sheet steel, usually of 20 gauge, into the desired cylindrical shape by means of a cornice brake. The vertical edges are then united. The point, or boot, is stamped from a single piece of 16-gauge stock.

The core, by means of which the shell is placed, consists of two semi-cylinders, or cones, of steel which can be separated or brought together through the action of a series of wedges. A driving cap is attached to

The Raymond Concrete Pile





A represents the shell, driven in the ground.

B represents the exterior plates (¾ in thick) of the pile core.

C represents the stem of the pile core, made of extra heavy pipe of diminishing diameter as the lower end of the pile core is approached.

D represents the wedge shaped castings fitted to the exterior plates.

E represents the corresponding wedges fitted to the interior stem. This wedge is made of a steel casting, which also acts as a collar for coupling together the various sizes of pipes forming the stem.

F represents hinges linking the exterior plates and interior stem of the core. Note their position when core is expanded.

G represents the head of the core, made of cast steel hollowed out at the top to receive an oak cap block, which receives the blow of the hammer.

H keys to keep the exterior plates in place when expanded.

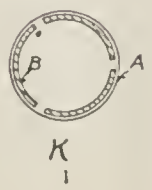
K represents cross section, showing opening between plates to allow for collapsing.

L Steel leads of driver

Fig. 1. Sectional view of Raymond pile core, showing collapsing and expanding device (Steam hammer in the leads resting upon the core.) In this illustration the shell is driven and the core expanded.

Fig. 2. Sectional view of pile core collapsed and ready to withdraw from the shell.

Note that wedges **D** and **E** are no longer in contact, thus allowing the plates **B** to collapse toward centre of core, leaving a space between plates **B** of core and shell **A**. Note also position of hinges **F** when core is collapsed.



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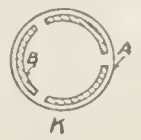

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the head of the core. After the core has been raised into the position assumed preliminary to driving the cones are separated and the largest section of the shell is slid up into position on it. The various smaller sections then follow in turn until the tip of the core is finally enclosed in the boot. The upper edges of each section are so placed that they overlap the lower edges of the section above, thus forming a close joint.

After the boot has been placed in position, the shell, propelled by the core within, is driven to refusal. The core is thereupon withdrawn by bringing the cones together, or collapsing the core, as the operation is termed. The shell, which is of sufficient strength to retain shape, remains permanently in the ground.

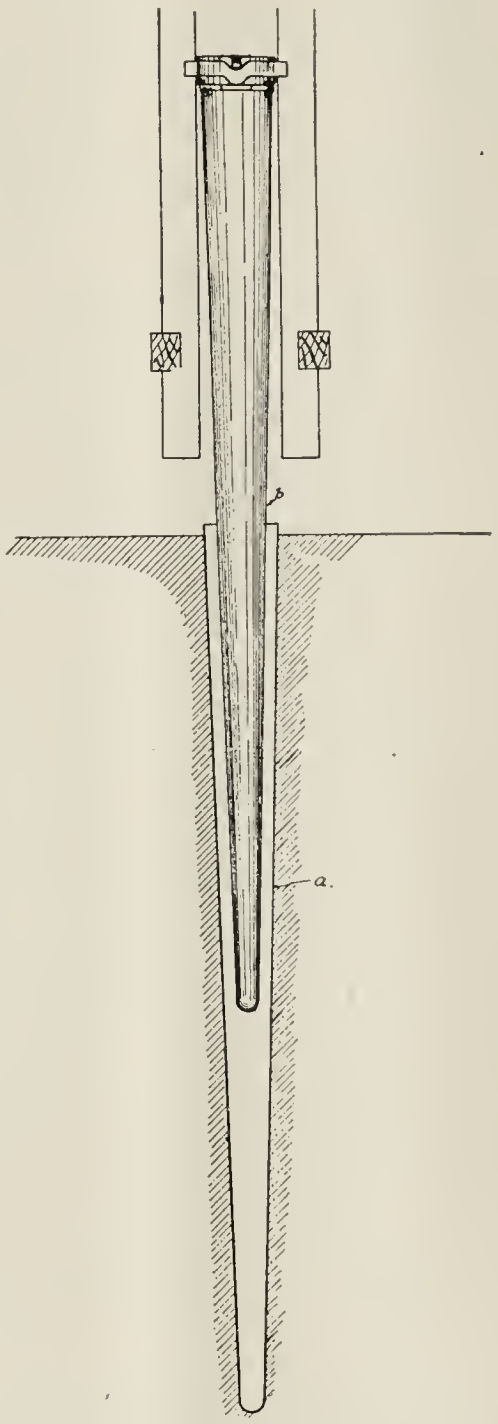
Before being filled, the shell is subjected to careful inspection. One method by which its integrity is determined is by lowering an electric light into the shell, thus disclosing to the inspector the contour of its interior and the condition of the seams. Any materials which may have seeped into the shell is siphoned out by a hose and pump. Should the shell be found to be distorted, it is either withdrawn or another placed inside of it, the distorted one giving way to such displacement by the opening of its seams.

After inspection, thoroughly mixed concrete, composed of one part good Portland cement, three parts sharp sand, and five parts crushed stone or gravel of suitable size, is poured in, being carefully tamped from time to time until the shell is filled.

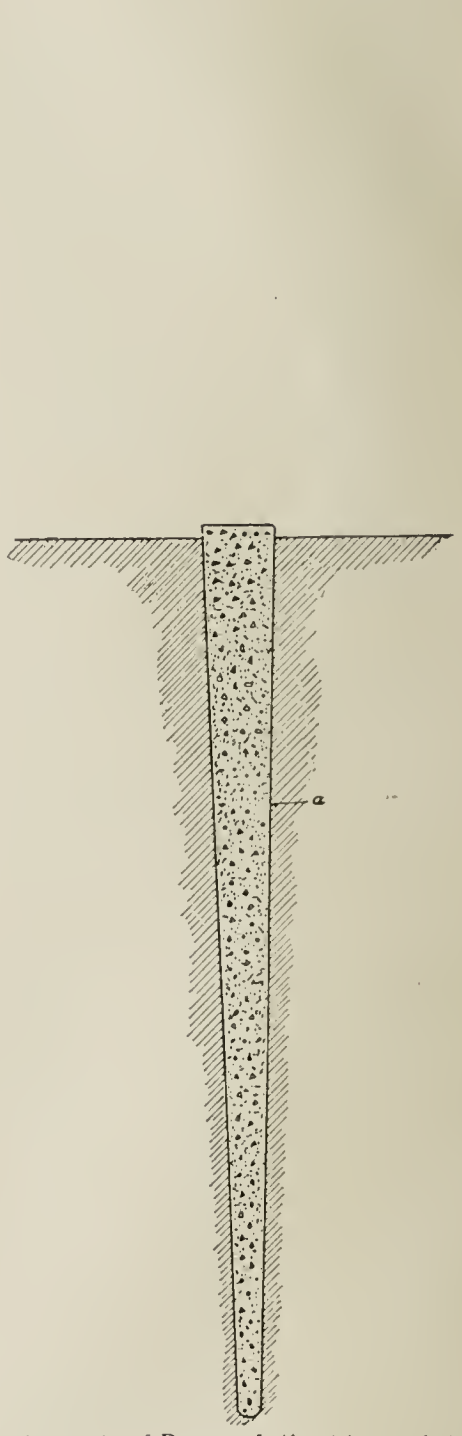
At times it is found desirable to use steel reinforcement for concrete piles. In the case of the Raymond system, this is accomplished with great ease. The rods or bars are placed in position in the shell before it is filled with concrete. This operation requires no unusual skill or knowledge. In this, as well as in all of the other phases of the manufacture of Raymond concrete piles, the element of time saving has received careful consideration. Raymond piles can unquestionably be placed more rapidly than other forms of concrete piling, as when the shell has been placed the driver may be turned to the task of driving another shell while the first is being filled.

One of the principal objections to wooden piles in their susceptibility to brooming and splitting from overdriving. In the case of concrete piles made above ground, a similar objection holds also, the impact of the hammer often cracking and splitting the concrete. In both instances, such defects may readily occur to portions of the pile concealed beneath the ground, a pile appearing perfect when it is in reality gravely injured.

The difference in bearing power between a conical and cylindrical pile was shown by an experiment. A Raymond concrete pile was tapered from 6 inches at the point to 20 inches at the head, was driven 19 feet until the penetration under two blows from 2,100 lb. hammer falling 20 feet was 7/8 inch. A wood pile 9½ inches at the point and 11 inches at the head and having the same length, 19 feet, as the conical pile, had a penetration of 55-16 inches under two blows of the same hammer, falling 20 feet. This pile was driven after the concrete pile and about two feet from it, thus showing the comparative bearing power between a conical and a cylindrical pile of the same length.



The core of a Raymond pile collapsed and partly withdrawn from the shell.



A completed Raymond pile without reinforcement. "A" shows the shell left in the ground.

Two drivers were used on the work, one with 2,240 lb. drop hammer and the other a steam hammer of the Vulcan make, weighing 3,000 lbs. The steam hammer was found more satisfactory, working much more rapidly. This was partly due to the fact that the steam hammer was mounted on a turn-table, and was able to turn in a circle by its own power. It was also provided with an extension top by which the core could be raised, or lowered, if necessary, in a trench below the driver.

The first piles were driven until twenty blows with the steam hammer caused a penetration of one inch. This was found to be very severe on the steel core, and later tests on loaded piles proved that it was unnecessary to have such a small penetration, and it was reduced to eight blows for a penetration of one inch.

When the driver with the drop hammer was brought on the work, some comparisons had to be made between the blows of the two hammers, so that the cores would be driven to the same penetration, to give an equal bearing for all parts of the building. A core was driven with the steam hammer until the penetration with eight blows was one inch. This core was detached from the leads of the steam hammer and left standing in the

ground; then the driver with the drop hammer was moved up and four blows from the 2,240 lb. hammer, falling 20 feet, were found to drive it one inch, or a penetration of ¼ inch for a blow. As previously stated, eight blows of the steam hammer in rapid succession drove the core one inch, and the conclusion was reached that one blow of the drop hammer was equivalent to two blows of the steam hammer.

The tests were made by loading the piles, and it was estimated all piles with the same penetration as the test piles would have the same bearing power. 17½ foot pile driven with 20 foot core, 6 inches in diameter at the point and 20 inches at the head, having a penetration of one inch under twenty blows of the steam hammer, was loaded with 41 tons. Levels were taken during the loading and at intervals for one month. At the end of the month, the total settlement was 0.007 foot, or 3-32 inch.

Another 28½ foot pile driven with a 30-foot core, 6 inches at the point and 20 inches at the head, had a penetration of 5-16 inch under ten blows with the steam hammer. This pile was loaded with 42 tons. Levels were taken during the loading, showing a settlement of 0.002 foot, and at intervals for one month, showing no additional settlement. This pile was driven outside of the old sea wall in that portion of the land reclaimed from the Severn River, which had been filled with sand and mud three years previously.

A test pile was driven at the northerly end of the building on that part of the ground reclaimed from the Severn River. This pile was driven with a 30 foot core, a distance of 22½ feet, having a penetration of one inch for eight blows with the steam hammer. The diameter of the pile was 6 inches at the point and 16 inches at the head. It was loaded with 41 tons and had a settlement of 0.007 foot, or 3-32 inch. Ten days later it showed a total settlement of 0.009 foot. The load was then increased to 45 tons, with no additional settlement, and finally it was increased to 66½ tons, showing a total settlement of 0.035 foot, or less than 7-16 inch. There was no additional settlement when the load was removed six days later.

Concrete mixture 1-3-7. Length of core, 30 feet. Length of pile, 22½ feet. Diameter of pile head, 16 inches. Diameter of point, 6 inches. Penetration, one inch for eight blows No. 2 Vulcan steam hammer. Concrete 13 days old at beginning of test. Ground filled with sand and mud in 1901.

It will be noticed that the pile rose about ⅛ inch when the load was removed. This difference was at first supposed to be an error in the level work, but was checked several times, giving the same result. This led to a study of past records on piles of other systems, and it was found that this rising after removing the test load had occurred on piles in various parts of the country. It was assumed to be due to the elastic nature of the soil.

In preparing the pile for a test a spike was grouted in the concrete top, then two double 12 inch I-beams were placed on top of the pile, leaving room enough between them for a level rod to be held on the spike. On the I-beam a platform was made of 12x12 inch beams, 12 feet long, projecting on either side. This platform was loaded with chain, leaving a hole in the center for the level rod. An elevation was taken on the spike before loading, and while the load was being applied, also at intervals for a month. These elevations were taken from a nearby bench mark.

The concrete as a 1-3-7 mixtures with Portland cement, sand and ⅛ to ¾ inch gravel. The average of 78 neat cement Government tests was: twenty-four hours, 308 lbs.; 7 days, 661 lbs.; 28 days, 745 lbs.

The Simplex concrete pile is built up and molded right in the hole where it is to be planted to carry its load. Its body of plastic concrete is squeezed firmly and directly against the surrounding walls of the hole with nothing between to break the intimate bond between it and the surrounding earth. It is a cylindrical pile; the bottom end, way down in the hard pan where the load must ultimately be carried, is as large in area as the top and gives the pile a base suitable for weighty buildings. The shocks of the hammer for penetrating the earth fall upon the steel driving form, so that the concrete is never disturbed after it has taken its initial set.

The method of planting Simplex piles is this: The driving form, a large steel tube 16 inches outside diameter with ¾ in. thick walls, and long enough to reach hard pan, is closed at the bottom end with a loose cast iron point which helps penetrate the soil and keep the dirt out of the tube. It is driven down to the desired depth, the tube is filled with soft concrete and then slowly pulled out of the ground, the cast iron point remaining at the bottom of the hole and the concrete flowing through the open lower end of the tube, filling every crevice in the hole, where it is left to set without any further disturbance. Sometimes the cost of the cast iron points can be saved by using a driving form fitted at the bottom end with a pair of hinged jaws, which close into the shape of a point while driving and open to the full extent to the pipe while pulling.

This is broadly the Simplex system which can be adapted to any kind of soil. Sometimes reinforcing members are inserted.

The proper driving of Simplex piles is in all cases in the hands of an experienced foreman, who has had long training and thoroughly understands the requirement of good work. Little dependence is placed on formulas for determining bearing power. Generally speaking, a 3000 pound drop hammer is used with a fall of ten feet. At least two hundred blows are given and a final penetration of one-half inch per blow is sought.

The working load of a Simplex pile is generally taken as thirty tons. This has been justified by long experience and many test loads. There may be special cases where this loading is varied to suit the nature of the soil.

Following is a list of test loads applied to Simplex piles:

Place	Length	Load Tons	Settle't
U. S. P. O., Lawrence, Mass.	11′ 3′	40	None
U. of Pa., Philadelphia	14′ 3′	70	½″
Westinghouse Mach. Co., burg	35′ 0′	300 (5 piles)	None
N. Y., N. H. & H. R. R., Boston	28′ 0″	35	½′
French Gov., Lyons, France		270 (4 piles)	None
Produce Exch. Bank, Munich, Germany	22′ 9″	40	None
Exposition Buildings, N. Y.	30′ 0″	45	None
Fish Market Baltimore	27′ 0″	45	None
Municipal Lodging House, N. Y.	18′ 8″	50	⅜′
Grand Trunk Ry., Stratford, Ont.	16′ 0″	150 (3 piles)	3-32′
Iron City Brewery, Pittsburg, Pa.	16′ 9″	47	None

All tests have been successful and satisfactory to the engineer in charge. (W. M. Brott in Industrial Magazine.)

PURCHASE A COAL MINE.

The Lake Shore Portland Cement Company, of Sandusky, Ohio, advises us they have purchased in Athens county, Southern, Ohio, a coal mine of 500 acres, fully equipped. The coal is especially adapted for the manufacture of cement.

They also advise that contracts for the cement machinery will be let this month and that their buildings are already up. All the buildings are of cement and steel frame construction. They will probably be ready to ship cement about May 15th.

The Portage Silica Sand and Gravel Company, Stambaugh Bldg., Youngstown, Ohio, inform us that they are building a large gravel plant at Garretsville, Ohio. They are installing a steam shovel, crushers and conveying belt machinery.

VALUE AND COST OF STEAM CURING OF CONCRETE BLOCKS.

A great advance in the use and reliability of concrete building blocks has been made possible through the steam curing of such blocks. The object of this paper is to give an insight into the methods and system used by the Central Stone Company. It is to be understood, however, that nothing said is to be inferred as advancing any claims as to the superiority of the product.

A block cured with steam vapor is harder and stronger at the expiration of 24 to 30 hours than a block cured by the old way of sprinkling or spraying at the end of 7 to 10 days. The method of manufacture is as follows: The blocks are made in ordinary machines and transferred into the ovens where there is no sun or current of air to cause then to dry before they start to set. As soon as an oven is filled it is closed and within one to two hours the steam is turned on and it immediately condenses upon the block the same as dew on grass, and in less time than it is possible to spray a block, it is filled with moisture. In this way a block can be given so much moisture that it will become mushy and mash before the cement sets. This fully refutes the argument that steam curing dries the blocks before they have the proper amount of water.

If a block produced in 24 hours is equally as good or better than a block made in 7 days under the sprinkling system, is this point not worth considering in installing a steam-curing plant? Further, blocks can be delivered upon a contract within 48 hours after starting the plant, doing away with the one great objection the buyer has against concrete-blocks—that of being compelled to wait several days for them after placing the order. A denser block can be produced as the steam does not wash any of the cement from the block, as is the case with the sprinkling system. Also the color of the blocks is more uniform, regardless of the cement used. I have made blocks using dark, as well as light cement, and find them to be almost the same color; the steam gives them a lighter color than it has been possible to obtain before. With steam curing blocks can be made all winter, which gives the same opportunity to build with blocks as with brick. Again, in the case of rush orders, delivery can be made in 36 hours, or just as quick as stone can be obtained. It has been my experience that by steam curing, a better block is produced, both in color and strength, and a block that is much more salable than the old water-cured block.

We are using Kaw River sand, which is sharp and clean and costs delivered, including shrinkage and waste, $1.10 per yard. The price of cement at the present time is $1.25 per barrel. Our proportions range from 1 to 3 and 1 to 5 and our cost for 1 to 5 proportions is 3 cents per foot and 1 to 3 is 5 cents per foot. With one man to take care of the boiler, ovens, engine and the mixing of the materials, at $2.00 per day and two men to run the machines at $1.75 per day, we turn out 560 feet of rock. Allowing 50 cents for coal per day and $1.00 for office help, our blocks cost us for labor, very close to 1¼ cents per foot with the 3 cents added for material in the 1 to 5 blocks, the cost will be 4¼ cents per foot and of the 1 to 3 blocks, 6¼ cents per foot. These figures do not allow for insurance, wear and tear on machinery or the manager's salary. If three men were used on the machines, instead of two, the cost would be no greater for mixing, or for curing than it does for two men. As near as we have been able to ascertain, 1,000 to 2,000 pounds of coal will cure cure three ovens of blocks, each oven containing from 140 to 160 blocks. Our men on machines are able to turn out 140 blocks 32 inches long by 9 inches high, giving two square feet to the block. The blocks we make for building purposes are 4 inch shaped blocks, ranging from 4 to 32 inches. To build a wall from 8 to 12 inches in thickness, we use two 4 inch blocks, so cost of same must be figured on a 1 to 3 proportion for outside wall at a cost of 6¼ cents per foot and 1 to 5 proportion for inside wall at a cost of 4¼ cents per foot, making a total cost of a 12 inch wall, 10½ cents per foot. The hollow block we make is somewhat cheaper as it is only 9 inches high and 8 inches wide. We make all sizes, but this is the most used. It costs about one-third less for material and about the same for labor.

The cost of a plant will depend on the size and equipment desired. We have a 25 horse-power boiler, which cost with all piping and fitting, $225.00 and makes steam for 6 to 9 ovens. The ovens cost about $50.00 each. Almost any old boiler will answer, and the oven can be made not sheet iron (although I would not recommend this class of oven). I will endeavor to explain more fully the system we are using with the aid of the pictures.

(Paper read at the Cleveland cement show by F. S. Phipps of St. Joe, Mo.)

Our turpentine producing forests are likely to be exhausted in fifteen years, according to a report of the U. S. Forest Service.

THE MINERAL WEALTH OF THE UNITED STATES.

The value of the mineral output in 1907 was two billion sixty-nine million dollars, a six fold increase in 30 years. In 1880 the non-metallic products of the country, constituted 47 per cent of the total production, in 1907 it was 57 per cent. In 1880 the output of coal stood first in value, with iron second, followed by gold, silver, petroleum, lime, building stone, copper, lead and salt. In 1907 after coal and iron, came copper, clay products, petroleum, gold, stone, cement, natural gas and lead. Cement being the eighth in value.

Wood is still the leading building material, even in the larger cities. The annual building records of 49 leading cities of the country show, that the permits issued therein for buildings, 61 per cent were constructed of wood, and the remaining 39 per cent were of fire resisting material, no account being taken of the construction of dwellings, stores and other buildings in the country at large, outside of the 49 leading cities. where wood is usually preferred.

The members of the Interstate Cement Tile Manufacturers' Association who will meet in conjunction with the Northwestern Cement Products Association in Minneapolis, March 2nd, are located in eight states, and the Association is growing rapidly as manufacturers of cement drain tile are joining the Association to aid in the important work it now has under way.

The present membership represents an invested capital well over a million dollars, and the work of the Association will continue to increase in importance as the manufacture of cement drain tile is comparatively new, and is growing very rapidly, numerous plants in many states being now under construction.

A NEW IDEA IN CONCRETE MIXERS.

A. D. Ney, of Aurora, Ill., is placing upon the market a concrete mixer which picks up the sand and stone from the street, while the cement is fed into the hopper through a pipe by an air blast, at the same time, the finish mix is deposited in place automatically.

RESIGNED.

We are informed by Mr. Fred B. Franks, general superintendent Bath Portland Cement Company, Bath, Pa., that he has severed his connection, with this company on February 1. James A. Gish, assistant superintendent has also resigned as well as Mr. B. F. Stradley the general sales agent of the company.

THE VALUE OF CRUSHED DUST AS WATERPROOFING MATERIAL IN CONCRETE.

It is often stated that concrete can not be made water-tight without the aid of some special waterproofing material. In this connection I desire to call attention to a 2,000,000 gal. reinforced concrete reservoir for shop water supply recently built by me for the Union Pacific Ry. at Ogden, Utah, in which proper selection of aggregate which proper selection of aggregate resulted in tight construction. The reservoir had the following dimensions: 100 ft. wide, 160 ft. long, 21 ft. deep and 20 ft. from bottom to edge of overflow weir. The vertical side walls were 8 in. at the top and 18 in. at a depth of 10 ft. 6 ins., from which point a slope was made to the bottom 9 ft. 6 ins. below. This slope wall was 8 ins. thick and reinforced with ½ in. round rods, spaced 1ft. c. to c. The bottom was 6 ins. thick with the same reinforcing as the slope walls. The excavation was made in a very porous clay with the exception of some along the west slope where a coarse gravel was encountered. Some trouble was caused by the caving of slope wall on account of water seeping in. After the excavation was completed, 4 in. porous tile, was laid 14 ins. below the subgrade to dry it out before the concrete work could be started, these tile were run to a sump near the flush drain of reservoir into which the water was siphoned. They still remain in position and are connected with a 4 in. pipe into the flush drain, giving a free outlet to any seepage water that comes from the ground around the reservoir as well as what comes through the reservoir walls and floors. At the present time the discharge will not exceed a ¼ in. pipe under a 3 ft. head.

The concrete was made of one part cement, two parts ordinary sand, and four parts of crushed stone with dust in same. The stone was crushed in a small jaw crusher to 1 in. size, and was composed of quartzite boulders, porphyry and flinty limestone mixed, making a heavy percentage of crusher dust and sand. The concrete was machine mixed and to a consistency that would almost pour. The bottom was laid in block about 15 ft. sq. allowing a half-lap of 2 ft. The slope and side walls were put in with movable forms and in 20 in. layers running clear around reservoir. The finishing consisted of washing the walls and floor with 1:1 mixture of crusher dust and cement with an ordinary broom cut off to give a stiffness to the straws.

The water coming in this reservoir is snow and spring water, and is taken into an 8 in. wood pipe line 3½ miles above reservoir in mountains at an elevation of 6,300 ft. and carries only a trace of silting material. In the year this reservoir has been in service, the surface of water has varied, as the flow and consumption would increase and decrease, from 4 ft. to full 20 ft. depth, and at this date there is not a check in the entire surface of concrete that can be noticed. The small flow at the present time, coming from the tile placed under the floor, indicates that there is no seepage from the reservoir. In the past 4 or 5 years I have had occasion to examine several reinforced-concrete reservoirs and water tanks, and these examinations have proven to my mind that concrete can be made water tight by using stone crushed from a ¾ in. ring size, down to and including the dust, if enough good clean sharp sand is added to fill all voids completely. Yours truly,

A. Q. Campbell.
Assistant Engineer Oregon Short Line Ry.
Ogden, Utah.

DECORATIVE CONCRETE STONE.

It is now a generally accepted fact that properly made concrete possesses all qualities of the best natural quarried stone that would make it desirable as a building material with the exception of a pleasing appearance, which it often lacks.

It is durable, hard, strong in compression, can be made strong in tension by proper reinforcement with steel, is practically non-porous, fireproof, a good non-conductor of heat, and is without strata. Besides, it is generally cheaper than quarried stone.

It is also well known that it can be moulded or cast into practically any desired form, but then its appearance in color and texture, unless this process is done by experts in this special work, is nearly always so undesirable that it cannot be used successfully for ornament on buildings of any pretensions, especially those of a classical character, where columns, capitals, cornices, moulded courses and the like are employed.

In view of these facts, it is apparent that if we could make its color and texture pleasing to the eye, and its form accurate in every detail, so that it would not look moulded or cast, but have sharp arises and true lines, a very much larger field would be opened up for its use.

As our criterion of appearance fixed by habit is that of quarried stone, and as concrete is really itself stone, we naturally try to approach in color and texture the article made by nature, not necessarily because we want to imitate it for the purpose of deception—although in practice this is often the case—but because, in our imaginations, we have no better standard of looks.

It is, however, possible to make concrete appear as concrete, so that it can be readily distinguished as such, and still have it pleasing to the eye.

There are, generally speaking, four different methods of surface treatment successfully employed:

1st. To reveal the aggregates.

2nd. To make the concrete surface take on its color and texture from different substances placed in contact with the wet cement in the moulds or forms.

(These first two methods are generally the ones employed when it is desired to approach natural stone in appearance, although they are not necessarily limited to this purpose.)

3rd. To cover up the surface either with some kind of paint or plaster.

4th. To embellish the surface with materials of distinctive shades or colors generally in design, materials such as terra cotta, Moravian tile, colored glass, mosaic, brick, pebbles or other similar substances.

There are two ways of revealing aggregates, one by tooling the surface after the concrete has been thoroughly set and has hardened, which generally requires about four weeks before tooling can be done, and the other by scraping off the surface of neat cement before the concrete has thoroughly set, generally using a bristle brush for the purpose, and then washing the concrete either with plain water or a solution of muriatic acid. This latter method is generally employed within 24 hours of the time that the concrete is placed in the forms.

In order to attain good results by revealing aggregates, the aggregates must be worth revealing, and be pleasing in themselves; furthermore, they must be placed in the forms and manipulated after being placed, in such manner as to be uniform in distribution, and the markings of the forms, or the markings of successive layers laid at different periods of the work must not appear. They must be properly and carefully selected as to size. To be pleasing, aggregates must reflect light well and be distinctive in shade or color.

Black and white marble have been most successfully employed for this purpose, and instead of becoming dull with age, they weather lighter, and retain distinctive textural advantages over even most granites. There are examples of this work in structures in the vicinity of Boston that are twelve to fourteen years old, and look nearly like new. Crushed granite of some kinds serves very well, but requires,

as a rule, a small portion of black or white aggregate, or brilliant material of distinctive and different colors mixed with it to give it the desired "life."

It is almost a practical impossibility to so proportion the aggregates of a given stone with a view of reducing the voids to the utmost minimum, thereby necessitating the least amount of cement, so that when revealed, the appearance of the product will closely resemble the natural stone from which the aggregates are taken. The variable in this operation emphasizes the uncertainty and difficulty of the attempt.

There is another matter to be taken into consideration in the employment of aggregates, that is their size to conform to different designs. If sharp arises and fine ornamental details are required, small aggregates must be used; a very common error of design is the making of too fine detail for a concrete of large aggregate.

As selected aggregates are generally costly, it is often advisable to form only the surface of the stone of this selected material, placing it in position at the same time that the backing of rougher concrete is installed. If this be properly done a perfect bond between the face and backing is insured. This can be proved by the inspection of this material in a number of places in and about Boston, where it has been employed for twelve or fourteen years, and shows no signs whatever of disintegration.

(Paper read by Frederick A. Norris of Boston, Mass., at the Cleveland cement show.)

CASEY-HEGES COMPANY.

One of the most successful manufacturing concerns of today is the Casey-Hedges Co., Chattanooga, Tenn. This concern has been identified with the boiler business for the past 35 years, having started with a small plant and built up one of the largest and most successful concerns of the kind in the country. Their plant covers an area of four city blocks and is situated in the center of the southern iron district.

Their shops are equipped with all the latest boiler-making appliances, and their foundry is the largest in the south, having an output of 90 tons of finished castings per day. Their boiler shop has a capacity of nine com er shop has a capacity of nine complete boilers per day, besides the regular output of feed water heaters, tanks, etc.

Among their leading products in the C-H all-steel water tube boiler, being a most efficient and economical steam generator. It is especially adapted to cement plants. They also manufacture internally fired and return tubular boilers, feed water heaters of both the open and closed type, tanks, self-supporting and guyed smoke stacks, brick hardening cylinders, all kinds of plate iron work, grate bars, boiler fronts, etc. They will furnish all parties interested with catalogue upon application.

It is said that the Brant Portland Cement Co., of Brantford, Ont., will commence building their St. Mary's plant early in the spring. This company have an option of fifty acres of land, which, according to tests made, contains the necessary deposits for a good Portland cement.

CRUSHED GRANITE FOR CEMENT.

The Monarch Mining Company, 307 Culver Ave., Jersey City, N. J., are placing on the market Crushed Granite for facing, stuccoing, granolithic work, mausoleums, and all classes of ornamental concrete work.

This material makes a beautiful block; lustrous and brilliant. Artificial stone men state that it makes a perfect bond.

The use of this Crushed Granite will yield the builder more profit inasmuch as a building built or faced with this material commands at once a higher value than were it of the ordinary concrete block construction, which cannot be compared with the Crushed Granite.

In every case where ornamental concrete work is required the builder will be able to satisfy the most exacting.

One contractor recently used this material in facing one of the handsomest residence in Connecticut. The owner was dissatisfied with the appearance of the ordinary concrete block work when the building was completed, but now the contractor reports that the owner as well as the architect is more than satisfied.

The story of this particular job and the contractor's opinion of Crushed Granite will be sent for the asking and the company will send on a sample package of the Granite with prices which put it within the reach of every contractor.

The Denver & Northwestern Portland Cement Co., has been incorporated at Denver, Col., for $1,000,000. A plant with 1,500 barrels daily capacity will be erected at Golden. Officers areW. S. Campbell, president; J. B. Church, vice-president; F. B. Davis, secretary; G. N. Robinson, treasurer and H. Fleck, chemist.

Gideon L. Austin, superintendent of the Buckeye Portland Cement Co.'s plant at Marl City, near Bellefontaine, O., has been engaged by an American syndicate, which is building a cement plant at Yatchura, Japan, to superintend the work there and pilot the new Japanese plant through the early stages of preparation for the manufacture of cement.

The Atlas Portland Cement Co., commenced shipping cement in January on its Panama Canal order, in solid trains over the New Jersey Central Ry., to Jersey City, at the rate of 2,500 barrels per week, at Jersey City the cement is littered on tugs to Government steamers to Panama. Five government cement inspectors are at work at the Atlas plant- at Northampton, Pa., testing all government cement under the directions of Chief Government Inspector, J. C. Bennett.

Dallas, Texas is to be the greatest cement producing center of the South. The Texas Portland Cement Co.'s old plant has a capacity of 1,500 barrels per day, while the company's new plant has a capacity of 4,000 barrels per day. The South Western States Portland Cement Co., plant now under construction is to have a daily capacity of 4,000 barrels the combined output therefore will be 9,500 barrels per day.

SAWDUST AGGREGATES.

When saw dust is used as an aggregate for partition blocks or floor tiles in combination, with Portland cement. The sawdust must first be placed in a vat containing a thin solution of the milk of lime and be permitted to remain for several days. This treatment makes the sawdust fire proof and prevents undue expansion. The sawdust must be partially dried out before being used.

Floor tiles must be subjected to high pressure in order to make them dense and serviceable.

The U. S. Forest Service report shows that we now consume one hundred million railway wood cross ties, the average length, of each tie is 8 ft. which if laid end to end would measure 151,515 miles. This would extend over 6 times around the earth at the equator. This shows a vast field for the future concrete railway tie, which must eventually displace the wooden tie now in use. Here is where the inventor can find scope for his genius and reap a golden harvest that will satisfy the wildest dreams of revenue.

BIG MATERIAL HANDLING PLANT.

Several years ago the government planned to replace Lock No. on the Monongahela River with a larger structure, and a point was selected at the town of Brownsville, Pa., where a good rock bottom was found.

Traffic could not be interrupted as eight feet of water is maintained for navigation to Morgantown and means for handling material must be such that only that part of the river to be occupied by the lock was covered.?

Cableways, derricks and other means were considered, the former on account of their low first cost, but their adaptability was not as great as the necessity required.

A hoisting and conveying machine was needed that would have later motion the length of the proposed lock walls, and after considering all plans a traveling bridge with trolley was adopted. The scheme was conceived by Mr. John Seaver, engineer for the H. E. Talbott and Company, contractors, and the design let to The McGeorge Engineering Co., Cleveland, O., and the contract for building and erection to Victor R. Browning & Co., of the same city.

The contract was let in December, 1907, and two bridges built, and erected on tracks set on piling at the location of the lock, and in running order by April, 1908. This time included all drawings, shop work and erection, the piling and tracks having been placed in the meantime.

One bridge was set to excavating and the other to laying concrete, and it was estimated that they would displace 500 men.

The excavated material was piled on the river side and at the ends to form cofferdams, but there was about 17,000 cu. yds. to be dumped in scows to be carried away.

The main features of the machines are two towers each carried on six flanged wheels with axles in M. C. B. boxes, connected by a bridge with cantilever sections.

Each bridge carries one or two trolleys, depending on requirements, which can be transferred by running them off on trestle work on the bank. An extension of 27 ft. can be bolted to either bridge for operations beyond the reach of the main cantilever on the shore end.

The fabricated material of the bridges, trolleys and towers include 450 tons of structural steel and about 28 tons of cast iron, and 12 tons of steel castings.

The bridges have a span of 150 ft. from center to center of rails and a height in the clear of 32 ft., and are propelled by a winding cable attached to each end of the tracks and carried up, and over, to drums on the shore tower.

The mechanism consists of 2 motors of 50 H. P., reduced by a train of 2 gears to a 6 ft. drum, giving a speed of travel of 150 ft. per minute, and adding a weight of 20 tons to the shore tower, which is designed somewhat differently from the other one. By placing the propelling mechanism on this tower it afforded an opportunity to construct lighter trusses for the trolley tracks.

The bridges are 285 ft. long, which give a trackage of nearly that length for the trolleys, and by adding the temporary section an addition of 27 ft. is gained. The bridges were designed to lift 5½ tons, and the trolleys are equipped with a 50 H. P. motor for the hoisting rig. of 5½ tons capacity, and 30 H. P. for traveling, lifting at rate of 150 ft. per minute.

One trolley is being used with a 1¼ yd. orange-peel bucket is excavating and has operated at the rate of 50 trips per hour as the fastest time. The operators work in 8 hour shifts, beginning at 6 A. M. and continuing to 2:45 P. M. with 45 minutes for lunch. The trips with the bucket has varied from 276 to 409 in that time. This trolley is also used to set timbers and do other odd jobs. This leaves the other crane free to set forms and handle concrete.

The piling on the river side is arranged to carry three rails for the track of the concrete mixing plant, and the car which brings the cement from the storage bins on shore. This car has a capacity of 15 barrels and is self propelling, having a 5 H. P. motor and a speed of 8 miles per hour.

Scows of sand and gravel are tied up under the cantilever over the river and one trolley operates a grab bucket, supplying the mixing plant with proper material. The capacity of the storage bins at the mixing plant is 15 tons of gravel, the same of sand and

View of traveling bridge erected especially for above work for hoisting and conveying material and supplies. The Hayward Co's orange peel bucket is shown, connected with A. Leschen & Sons Wire Rope.

20 barrels of cement. The output when working steadily is 60 cu. yds. of concrete per hour.

One plant consists of a No. 5 mixer, electrically driven, which dumps the batches into a hopper, from which it is dumped into a specially designed bucket, that waits for a second batch before depositing at the required place on the walls.

Three walls are being built, the shore one 23 ft. thick at the bottom and tapering on bank side to 6 ft. at the top, and 42 ft. high, the middle wall is 20 ft. thick at the bottom, 20 ft. at the top and is 45 ft. high, while the river wall is 22 ft. at the bottom, 16 ft. at the top and 47 ft. high. The lengths vary, the shore being approximately 1150 ft. long, the center wall 520 ft. and the river wall 650 ft. long, and the three walls give a clearance in each lock of 56 ft. wide.

Stone abutments are to be built at four points connecting the shore wall with the bank, and also two heavy concrete wings on a line of the end of the center wall. These wings extend into the river bank, and the material on the cofferdams will be dumped between them.

A dam is to be built opposite the locks after the latter is finished, and they can be used for the passage of boats.

The bridges will be used till the fall of 1909, though one may be removed sooner to another job. The structural work is put together with bolts driven in reamed holes so that the task of dismantling will not be such a great one, and the length of usefulness greatly extended.

RAILWAYS IN ALASKA.

There are nine railways in Alaska operated by nine companies, as follows:

	Miles.
Seward Peninsula:	
Seward Peninsula Ry., Nome to Shelton	80
Paystreak Branch S. P. Ry.	6.5
Council City and Solomon River, Council to Penelope Creek	32.5
Wild Goose Ry., Council to Ophir Creek	5.
Fairbanks:	
Tanana Valley R. R., Fairbanks and Chena to Chatanika	46
Kenai Peninsula:	
Alaska Central R. R., Seward to near head of Turnagain Arm	53
Copper River:	
Copper River R. R., Cordova to Childs Glacier (Sept. 17.) Probably 11 miles have been built since September 17. Same railroad at Katalla, where there has also been some work done by a rival company, has built between 3 and 4 miles. At Valdez a few miles of track of the Alaska Home Ry. were laid in 1907.)	47
White Pass:	
White Pass and Yukon R. R., Skagway to White Pass (Terminal at White Horse, Yukon Territory.)	20.4
Yakutat Bay:	
Yakutat Southern Ry., Yakutat to Situk River	9

Portions of the Council City and Solomon River and of the Alaska Central are out of repair and not in use.

The Alabama Portland Cement Co., Ltd., works at Demopolis, Ala., head office, London, England, heretofore owned by English capitalists has been sold to James S. Pinckaid & Massy Wilson, both of Montgomery, Ala. The plant is valued at $200,000 and the purchasers take a portion of the stock under this valuation and agree to double the capacity of the plant by extending at least $200,000 in improvement.

Sandusky Portland Cement Co., of Sandusky, O., are supplying their White Portland Cement for use in the following important contracts:

In mausoleum construction at Decatur and El Paso, Ill.

On the Studebaker private residence, South Bend, Ind.

For setting and pointing Vermont Marble, Columbia Theater, St. Louis.

For exterior ornamental work on Tripp's Dancing Academy, St. Louis.

Exclusively on the Italian Gardens, Cheeseman Park, Denver, Colo.

For wainscoting in the new City Hospital, St. Louis.

Emigrant Savings Bank, New York City.

They are also furnishing their Medusa Waterproof Compound for the following important contracts:

100 cement cisterns being constructed by Board of Public Works, San Francisco, Cal.

In the roofs of the Southern Pacific Ry. Co's. Hospital.

To the Quartermaster's Department, U. S. A. Key West, Fla.

In the cement vaults for the Title Trust Co., Seattle, Wash.

Exterior of plaster of the Ferry apartments, Seattle, Wash.

In the Diamond Ice Co., plant, Seattle, Wash.

The Piedmont Portland Cement & Lime Company, Davitte, Ga., let the contract for a 500 barrel cement plant to Chalmers & Williams, Commercial National Bank Bldg., Chicago, Ill., including Kennedy crushers.

Mr. M. R. MacKinnon has been placed in charge of the Sales Department of the Continental Portland Cement Company, vice, Frank S. Clark, resigned. General offices, Syndicate Trust Buildings, St. Louis, Mo.

The Chanute Cement & Clay Product Company, main offices, Akron, Ohio, write that their buildings are now all up at Chanute, Kans., where they are building a new cement plant. The machinery is now being shipped. The Bonnot Company of Canton, Ohio, will install the tube mills.

RECENT ORDERS FOR McCULLY CRUSHERS.

With the gradual improvement of business conditions generally the demand for crushed stone is increasing to such an extent that many existing plant are largely increasing their equipment, and a number of new enterprises are preparing to supply crushed stone during the coming season. Among the companies which are either increasing their plants, or putting in new ones, the following have purchased the McCully crushers and auxiliary machinery manufactured by the Power and Mining Machinery Company of Cudahy, Wis.

Hiner Stone Co., Lima, Ohio—Complete crushing plant consisting of one No. 6 and one No. 3 McCully crusher, ith elevators, screens, etc.

Chicago & Northwestern Ry.—Crushing plant at Winona, Minn., consisting of one No. 7½ and No. 5 McCully crusher with elevators, screens, hoists, etc.

Brownell Improvement Co., Thornton, Ill.—One special No. 10 McCully crusher having opening 27″ wide and one No. 6 McCully crusher, screens and elevators.

Dolese & Shepard, Gary, Ill.—Complete crushing plant consisting of one Mammoth McCully crusher having 42″ receiving opening, four sets 54″ x 24″ Superior crushing rolls, ten revolving screens and three special pan conveyors.

Illinois Stone Co., Chicago, Ill.—Addition to existing plant consisting of one No. 10 McCully crusher.

Granite Rock Co., Watsonville, Cal.—1 No. 7½ and one No. 3 McCully crusher with elevators and screens.

Woodruff & Pausch Stone Co., Columbus, Ohio—One Mammoth McCully crusher with 42″ opening, revolving screens, etc.

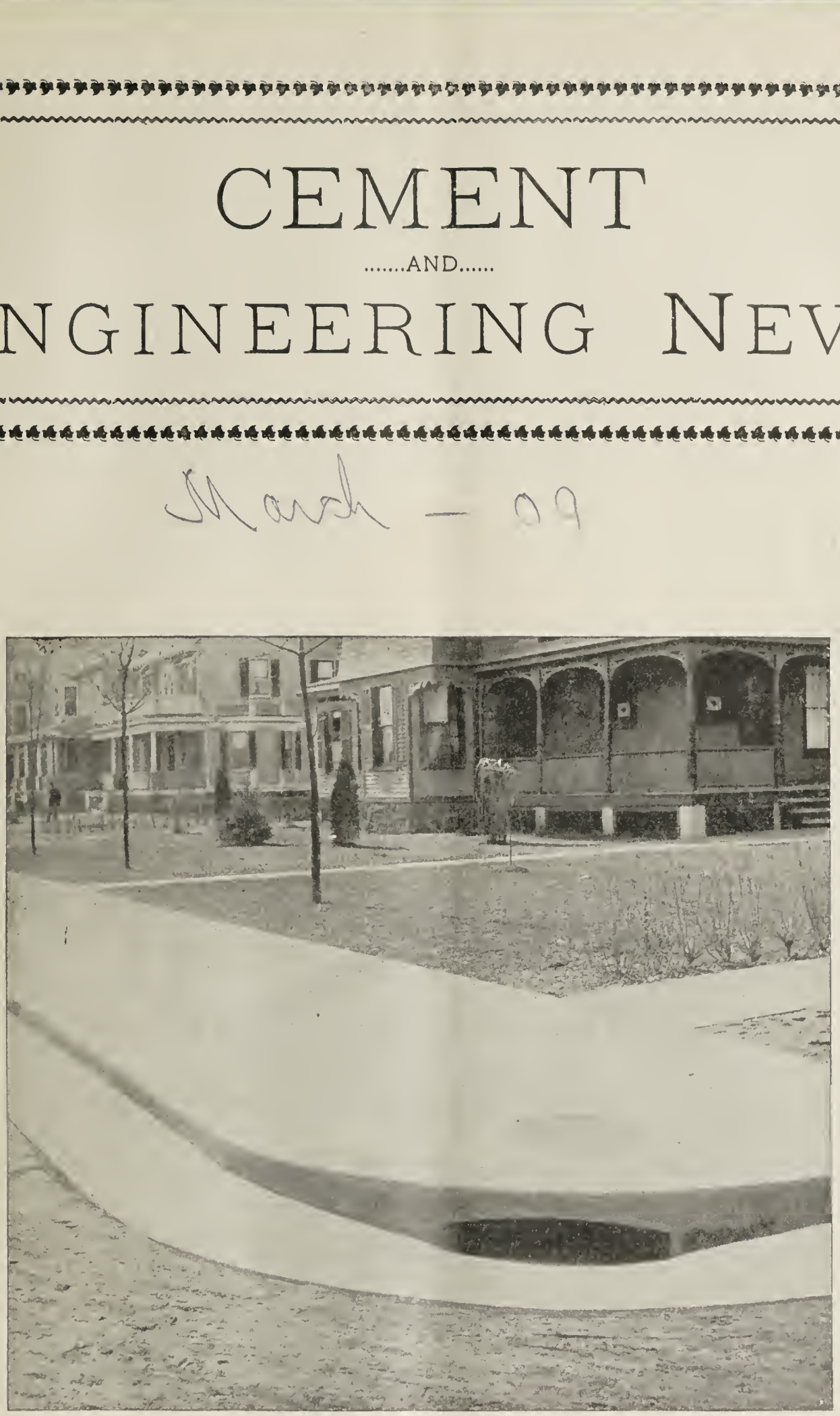
Chas. Longnecker & Co., New York City, for the Stewart-Kerbaugh-Shanley Co., High Falls, N. Y.—A portable rock crushing and concrete mixing plant including one No. 4 and No. 3 McCully crusher, one set of crushing rolls, elevator and screens.

Carnegie Steel Co., Youngstown, Ohio.—One No. 5 McCully crusher.

The tendency towards the use of steam shovels in quarry work is clearly shown by the very large crushers which are now being installed, as shown by the above list. The development of these large crushers has been rapid, as evidenced by the fact that up to the year 1906 the largest gyratory crusher built was the No. 9, having a receiving opening of 21″ wide. The Bucyrus Company of South Milwaukee, Wis., make steam shovels for cement manufacturers.

CEMENT
.....AND.....
ENGINEERING NEWS

March — 09



THE ABOVE CUT IS A VIEW OF THE CONCRETE WALK, GUTTER AND STEEL-BOUND CURB, WITH SEWER BASIN INLET AT THE CORNER OCEAN AND CHURCH AVENUES, BROOKLYN, N. Y. PARTICULAR ATTENTION IS CALLED TO THE CURB, WITH ITS EDGE PROTECTED BY A GALVANIZED ROUNDED BAR, WITH A DOVETAILED WEB OR TONGUE EXTENDING INTO THE CONCRETE. GIVING PERFECT PROTECTION. THIS PATENTED CURB IS KNOWN AS THE WAINWRIGHT STEEL-BOUND CONCRETE CURB.

(See page 70.)

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all its branches Engineering notes, public improvements, and facts and opinions drawn from practical experiments will be welcome.

THE NATIONAL BRICK MANUFACTURERS' ASSOCIATION'S ADVERTISING PROPAGANDA.

The 23rd annual convention of the National Brick Mfrs. Association, which was held at Rochester, N. Y., on Feb. 3, 4 and 5, discussed the subject of advertising brick in order to counteract the use of concrete in building constructions, which is making extensive inroads on brick building all over the country. This condition of affairs is made very clear in the following statement made by one of the speakers at the convention: "A New York Brick manufacturer said to me the other day that it was getting to be provokingly common, to be told by architects, when I call on them to present the advantages of brick for a particular house that was being designed, that the owner, had specified concrete—please note and weigh carefully, the statement—the owner, not the architect, decides for himself the material to be used." The cement industry, by the liberal use of printed advertising matter, had brought home to the general public the message that concrete was a valuable building material, and this message had been received with confidence. Concrete has entered the great consumers market, and is daily gaining a large part of it through liberal advertising. The brick manufacturers are beginning to understand that they are standing on losing ground, and that something must be done to reawaken public interest in brick building construction. With this end in view, a fund is to be raised to be devoted to advertising the use of brick. This fund is to be raised either by subscription from each brick manufacturer, or by placing an assessment of one or two cents on each thousand brick produced by individual manufacturers.

The paving brick manufacturers, have already an advertising propaganda. They place 1 cent per square yard on all brick pavements laid, which goes to the local state association, and 25% of all collections paid, is paid to the National Committee. Ten men are employed to visit property owners on streets to be paved, advocating the use of brick. They travel from city to city, get on friendly terms with city engineers, call meetings of property owners, and go before these meetings and advocate the use of brick as being superior to all other kinds of paving material. Lists of property owners on streets to be paved are made out, and sent to the secretary of the paving brick manufacturer's association. There is a publicity bureau from whence literature is sent to each person on these lists, commending the good qualities of brick pavements. This combine now controlls 90% of the brick paving output of the country and effectively controls the price of this commodity in seven states. In the South, they ask and get $43 per thousand for their product, whereas the price was only $13 per thousand before the Association was organized. The clay products manufactured in 1907 were valued at $149,697,000 with 5423 establishments engaged in the manufacture of brick and tile. The Hollow Clay valued at $934,357. The value of building tile production for 1907 was common brick output for the same year was $58,785,461, while the value of Portland cement output for the same year was $52,466,186. The common brick output for 1907, was valued at $6,319,275, which was more than the Portland cement output for that year. These figures are given to show the magnitude and extent of the brick industry which is about to array itself against the cement and concrete industry, by means of a comprehensive and well organized scheme of systematic advertising all designed to arrest the growth of concrete construction; while the cement manufacturers derive direct benefits from all kinds of advertising which promotes the use of cement building construction, they as a class have not been liberal advertisers. They have reaped benefits from the more liberal class of advertisers, such as cement block machine manufacturers, the reinforced concrete contracting companies and cement sewer pipe manufacturers. Mr. W. S. Purington, of the Paving Brick Manufacturer's Association, in addressing the last Brick Manufacturer's Convention, said: "there is nothing we can do, that will bring bigger and better returns than publicity. Ever since I have been here, I have listened to the hard luck stories of the building brick manufacturers. Have you heard anything of this sort from the paving brick manufacturers? No."

The cement industry will grow as the public becomes educated to its use, and will prefer certain brands of cement in proportion as such brands are liberally advertised. We remember reading an article in the British trade report published by the medium by which the British consuls express their opinions on the affairs of trade from various parts of the world. This particular article was on advertising as a trade promotor. It read: "Man-

Smooth Rolls for Reducing Lime stone and Shale in Cement production.

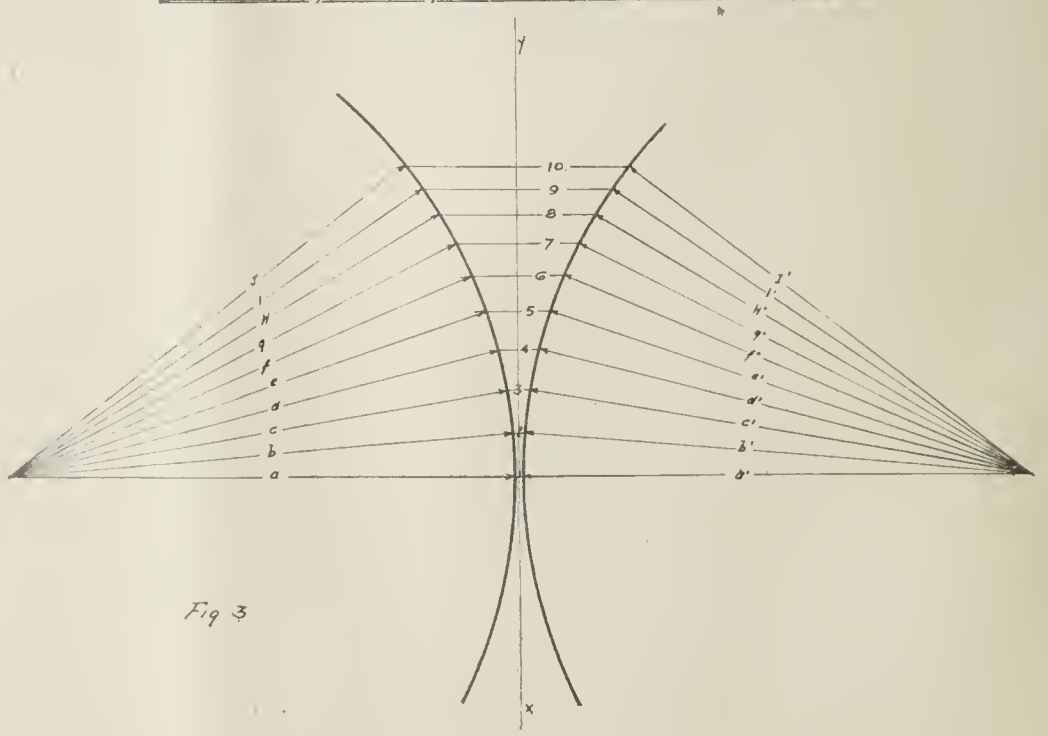


Fig 3

ufacturers desiring to establish an increased trade for their products, must pursue a system of advertising, originating at the home office in order to create a demand for their products. If the advertising is left to the local dealer, substantial results cannot be obtained; while if the territory is covered by advertising from the home office, a demand is created directly with the public who demand the article from the dealer, and the dealer finding a demand existing for the commodity will sooner or later be compelled to handle the article. The manufacturer is thus placed above the dealer, whereas, if the dealer places the advertisement, the manufacturer is more or less at the mercy of the local dealer."

Some of the American Portland Cement manufacturers are now devoting one per cent of their gross receipts to advertising. If the other manufacturers would adopt the same policy, the cement industry would certainly make greater progress. Something will have to be done to compete with this combined clay interest which is taking the field with such a liberal advertising propaganda.

A CORRECTION.

In our February issue, we stated that the Marquette Portland Cement Co. was about to increase their capital to $2,000,000 and their output to 6000 bbls. per day. This we found was an error. Their capital stock will remain the same, i. e., $700.000 and the increase in output to 6000 bbls. per day will be provided for by the Company's present surplus.

ROLLS FOR REDUCING LIME STONE AND SHALE IN CEMENT PRODUCTION.

During the past 10 years in which Portland cement production in the United States has increased nearly 500% there have also been developed and patented various classes of mills and rolls for reducing lime, stone and shale to such sizes as are required for Ball-mill seed, usually ¼ in. or less, among the rolls developed there are several types on the market, viz. corrugated, semi-corrugated and smooth.

It is the writer's intention in this article to point out briefly some of the disadvantages of corrugated rolls, which are geared together, with one roll having a drive pulley, and the corrugation on the rolls, as well as the driving gears operating in mesh, clear, I have compared the principle and in order to make this perfectly characteristics of this type of roll with a smooth face roll.

Corrugated Rolls for Reducing Limestone and Shale in Cement production.

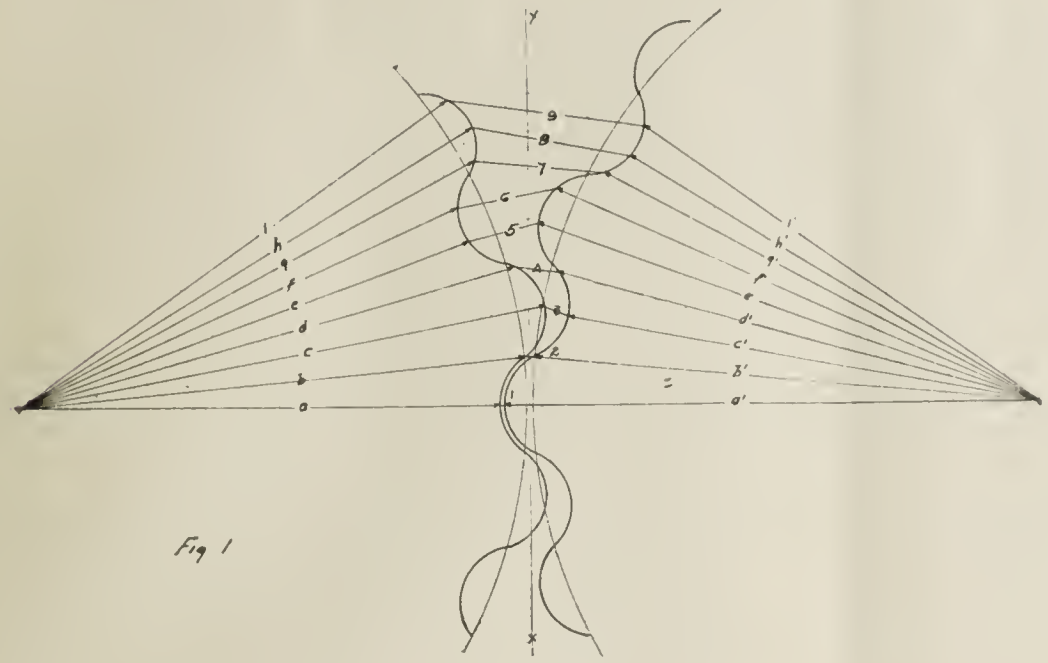


Fig 1

Referring to Fig. 3 which is a smooth face roll, it will be observed that the resultant compressions or crushing stresses 1 to 10 are and form true right angles with the tangent x—y, which conditions gives the maximum effort with the minimum *P* input, or in other words the crushing points on the two rolls is at its maximum when the resultants a—a to j—j forms an exact right angle with the tangent x—y, which is the most economical conditions when the quality of reduction is compared to the *P* required

Now in order to form a positive grip and increased output there was developed the corrugated rolls. Fig. 1, it is apparent however in such rolls, that there must necessarily be a heavy friction co-efficient and disproportionate increase in *P* required to operate the Rolls and in maintenance, especially the heavy wear caused by friction in the corrugation caused by the resultant efforts changing their relative positions independent of each other, causing the rolls in time to wear uneven (hollow in the centre) increasing the size of the reduction, without any means of adjustment, upon examination of the resultant stresses or crushing efforts, it will at once be noted that they are very much distorted, changing from an incline angle d—d to a decline angle e—e and passing through a right angle with the tangent, during this process there is developed a tremendous friction, which when added to the distorted resultants 1—9 will greatly increase the *P* required to operate the corrugated rolls over smooth rolls, when operating under the same conditions and built along the same general charac-

Corrugated Rolls for Reducing Limestone and Shale in Cement production

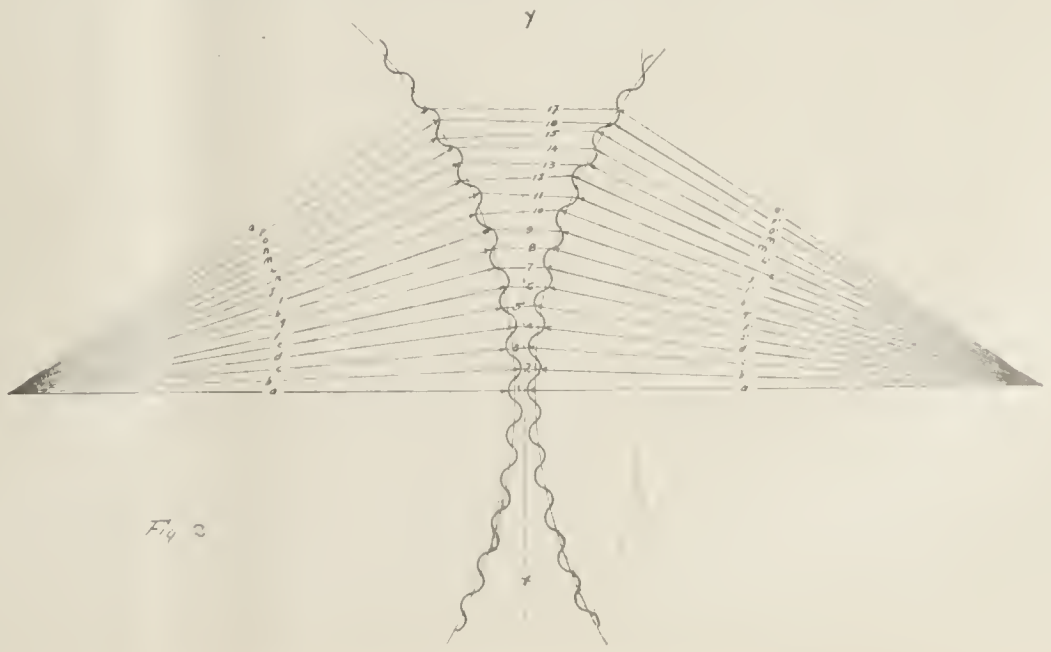


Fig 2

teristics, by solving the various triangles in Fig. 1 and Fig. 3 which are rolls built along the same general lines, it will be apparant that the corrugated rolls on account of the distorted resultant will require approximately 17% more power then the smooth rolls, when both are operating under the same condition and are delivering an equal output. It would be practically impossible to calculate the power required to overcome the friction above referred to but from experiments made it has been demonstrated to be between 3 and 5% and taking the average or 4% and adding this to the 17% we would have a net loss of 21%, in other words the corrugated rolls would require 21% more power to drive them than smooth rolls, when delivering an equal amount of raw material.

Now by referring to Fig. 2 there is shown a roll which in a large degree eliminates the objections of the corrugated rolls and largely possesses the avantages of smooth rolls, it will be noted that the resultant stresses are practically all at right angles to the tangent x—y, which gives the most economical operating condition, these rolls are what might be called an average between the corrugated and smooth rolls, the corrugations do not however, operate in mesh and are also of much smaller pitch than those shown on Fig. 1, the distortions are practically overcome, they also possess another decided advantage over those shown in Fig. 1, namely should they wear partially hollow in the centre (which they are bound to do) they could be put in a lathe and the surface made paralleled to the axis again by turning of the tops of the corrugations, of course this process could not be kept up continually as you would ultimately obtain a smooth set of rolls, in which case the tires should be removed and new corrugated tires substituted, such truing up could not be done to those shown in Fig. 1 as they operate in mesh. (Henry A. Tiemann, Schenectady, N. Y., formerly superintendent Penn Portland Cement Plant.)

In removing some natural cement concrete work in the harbor at Brest, France, which had been covered with sea water for 100 years. Iron bars found embedded in this concrete, did not show the least indications of rust, showing that concrete is a perfect preservative of iron. It must be understood, however, that iron does not rust as easily as modern steel.

PROTECTING CONCRETE CURB CORNERS.

The necessity of protecting the exposed corners of concrete masses, such as street curbs and various forms of concrete, has long been recognized by engineers and experts, and several methods of affording this protection from external injury have been tried.

The use of an angle iron on the corner of a concrete street curb is a natural conception, but a light angle iron cannot be made to stay in place, and a heavy angle iron more than doubles the cost of the curbing. Flat plates have frequently been bolted to the corners of concrete curbs or other concrete shapes, but have been found to be too expensive. The use of a round iron rod or of a hollow iron pipe filled with concrete has also been tried.

In 1889, H. H. Wainwright first devised a permanent and practical

Protecting Concrete Corners.

means of protecting the corners of street curbs. In a few years the question of concrete protection resolved itself into the simple proposition, namely, that the purpose for which this protection was required could best be accomplished by the use of a soft steel rounded head T bar, with a dovetailed web projecting into the concrete. Upon the dovetailed web largely depends the success of this bar. Its solid rounded head, and the shape of the head where it joins the concrete permit a proper finish of the latter. The bar is galvanized to prevent rusting.

The cut shown here represents a section of this bar. When the bar is properly set in the concrete, it is self-anchored, and the concrete finishes at the external surface of the bar not in a thin web, but in a body sufficiently heavy to avoid splitting away from the metal. After the bar has been in place a short time, it takes on an appearance so like the concrete that there is no staining of the cement surface. All of these features, including the galvanizing of the bar, its general shape and the integral dovetailed anchorage, have been covered by patents issued to H. H. Wainwright, and now owned by the Steel Protected Concrete Co., Real Estate Trust Bldg., Philadelphia, Pa. Printed directions for the use of this corner bar and the construction of concrete curbs and gutters will be mailed free of charge to anyone desiring this information.

The Steel Protected Concrete Co. is selling these bars at retail to responsible contractors at figures considerably lower than formerly represented the cost of manufacture.

The result of this policy has been the use of over 2,000,000 feet of these bars within the last few years in the United States, and the Wainwright system of curbing is now laid in over 150 different cities, some of which are using this curb to the exclusion of all others. It is claimed to be not only the cheapest durable street curbing that can be made, but its ornamental features also appeal to people interested in curbing.

The Steel Protected Concrete Co., has given its exclusive attention to the question of steel-bound concrete curbing for twenty years, and in the light of this experience its contention that the Wainwright galvanized steel corner bar is an ideal means of protecting the exposed edges of concrete, and is particularly adapted to street curbing, carries weight. The steel bar is also largely used for the protection of the corners of steps, sills, columns and other exposed concrete edges.

REINFORCED CONCRETE BARGE MODEL.

E. H. Allman of Mobile, Ala., constructed a reinforced waterproofed concrete barge complete in every detail consisting of a hull, with covered deck, pierced by hatchways with removable hatch way covers with deck house. Hawser posts, and captstain all constructed of Madusa Portland cement and waterproofing, was exhibited in the Sandusky Portland Cement Company's booth at the Chicago Cement Show, in a large tank filled with water as an exhibit to demonstrate the effective properties of the Madusa waterproofing compound, this exhibit attracted great interest at the show as one of the novelties to which Portland cement can and is being applied.

The Glens Falls Portland Cement Co. has been purchased by the Alph Portland Cement Co. The minority stockholders have been given 60 days to sell their stock at $175 per share, most of the original stock was purchased at from $70 to $90 per share. The president Geo. F. Bayle hold 1,000 shares.

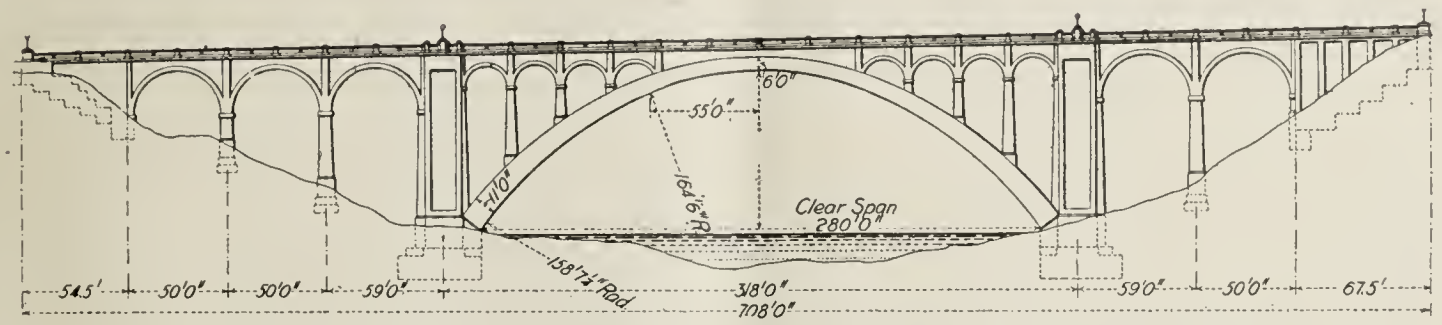
THE LARGEST CONCRETE ARCH EVER BUILT.

Will Span Rocky River Gorge on the Western Boundary of the City of Cleveland.

A reinforced concrete viaduct, with a central arch having a clear span of 280 ft., is being built by Cuyahoga County, Ohio, to carry Detroit avenue over Rocky River, near the western outskirts of Cleveland. The site of this structure is about half a mile from the mouth of the river in Lake Erie, the river having been dredged to a depth of about 20 ft. up to this point. The banks are steep on both sides, rising to a height of nearly 100 ft. above the water. The viaduct is also located in such manner that it will be fully exposed to view from all directions. A design of more than ordinary character was thus required by the exposure to view, the great height and the location in a rapidly developing residential district, practically a part of the city of Cleveland. These requirements have been met fully in the adopted design, as may be seen from the reproduction of a wash drawing of the structure printed in the current news supplement of this journal last week.

The viaduct replaces an existing steel bridge carrying a single electric railway track, and the large volume of highway traffic already tributary to Detroit avenue. This existing bridge is being continued in service while the new one is under construction parallel to and immediately downstream from it. Any difficulty from handling traffic during construction is thus avoided.

The new bridge will comprise the 280-ft. span at the middle, with three 44-ft. approach spans at one end and two of the same span at the other end. While the approaches to the central arch thus vary somewhat in length, the architectural symmetry of the structure is preserved by heavier retaining walls at the shorter end than those which connect the three-span approach to the street grade.



Elevation of the Rocky River 280-Foot Span Concrete Arch Bridge.

The total length of the viaduct from abutment to abutment is 708 ft. The structure carries a 40-ft. roadway, with an 8-ft. walk on each side, and has a total width of 60 ft. 4 in. The roadway is designed to carry 60-ton double-truck electric cars on the two tracks that will be laid on it. The sidewalks are designed for a live load of 80 pounds per square foot.

The central arch consists of two concrete ribs, each 22 ft. wide and 11 ft. thick at the springing line and tapering to 18 ft. in width and 6 ft. in thickness at the crown. These ribs are designed so the central line of pressure resulting from the dead load follows closely the center line of the linear arch. The concrete in them is accordingly not reinforced, as it is used to resist compressive stresses only, and under no circumstances can tensile stresses ever be introduced. The concrete in the ribs will consist of one part Alma Portland Cement, 2 parts sand and 4 parts broken limestone, this proportion being such, with the materials employed, as to leave a slight excess of cement in the mortar and an excess of mortar in the concrete. Slabs of stone will be embedded as closely together as possible in the arch ribs and normal to the centering, in order to increase the compressive strength of the masonry. The mixture is considered capable of developing a minimum compressive strength of 2,000 lb. per square inch on a 12-in. cube when 30 days old, 2,800 lb. per square inch at three months and 3,800 lb. at six months. As the stress in any part of the structure is designed to be less than 600 lb. per square inch, it is evident that the factor of safety is large.

The accompanying table gives the methods of deriving the stresses in the 280-ft. span arch ribs under different conditions of loading. For dead load the concrete in the main arch is considered to weigh 160 lb. per cubic foot, and the remaining concrete 150 lb. per cubic foot. The 60-ton street cars are assumed to produce a live load equivalent to 270 lb. per square foot over the first 10 ft. of the roadway on one side of the center line, 100 lb. per square foot over the next 10 ft. of the roadway and 80 lb. per square foot on the 8 ft. of sidewalk. Provision was made for a wind load of 30 lb. per square foot of exposed vertical surface.

The stresses due to temperature changes are derived from the formula:

$H=(E\ l\ \Delta\ t\ I) \div (\Sigma\ y^2 - e\ \Sigma\ y)\ s$

in which E = 288,000.000 lb. per square foot; l = 280 ft; Δ = 0.00006 per degree Fahrenheit; $t = \pm$ 30 deg. Fahr.; I/s = 62.33 per rib; $\Sigma\ y^2 - e\ \Sigma\ y$ = 13,241, and H=68,3000 lb. per rib.

The stress due to the shortening of the arch rib from the thrust is taken as 85 per cent of the temperature stresses caused by the fall of temperature.

The table gives the complete analysis for the dead load stresses. A similar analysis, determining and tabulating the same quantities, was made for the following three conditions: For dead load plus live load, for dead load plus one-half live load, and for dead load of arch ribs, spandrel piers and walls. For these three cases only the sums of the direct and eccentric stresses are shown in the table, these being used, of course, in determining the maximum and minimum stresses. For the condition of dead load plus one-half live load, the stresses were figured in full, as shown for the dead load stresses, for both halves of the arch, the totals for direct plus eccentric stresses being designated as R and L in the table.

The analysis from which the tabulated values have been taken was made by first constructing a basic equilibrium polygon and superposing this polygon on the neutral axis polygon of the arch, making the closing lines coincident. The notation is as follows:

y ordinate=distance from neutral axis to span line of linear arch.

z ordinate=distance from pressure curve to span line of basic polygon,
k ordinate=distance from neutral axis to closing line of neutral axis polygon.
a ordinate=distance from pressure curve to closing line of neutral axis polygon.
Eccentricity=$a - k$.
m ordinate=distance from pressure curve to closing line of basic polygon.
e=distance from span line of linear arch to closing line of neutral axis polygon.
Moment=eccentricity × rule pole distance.
Assumed pole distance, $H = 5{,}000{,}000$ lb.

The computations for the true H for the three principal loadings analyzed are shown herewith.

Finding Σy, Σy^2 and $\Sigma m \Sigma y$ for the dead load stresses, for the dead load plus live load, and for the dead load plus one-half live load, the following values are found:

For dead load stress—

$(\Sigma y^2 - e\Sigma y) \div \Sigma m y = 13{,}251/14966 = 0.882$ $\Sigma m y \div (\Sigma y^2 - e\Sigma y) = 14{,}966/13{,}241 = 1.13$ True $H = 5{,}000{,}000 \times 1.13 = 5\text{-}660{,}000$ lb.

For dead load plus live load—

$(\Sigma y^2 - e\Sigma y) \div \Sigma m y = 13{,}241/16{,}475 = 0.804$ $\Sigma m y \div (\Sigma y^2 - e\Sigma y) = 16{,}475/13{,}241 = 1.244$ True $H = 5{,}000{,}000 \times 1{,}244 = 6220{,}000$ lb.

For dead load plus one-half live load—

$\Sigma my \div (\Sigma y^2 - e\Sigma p) = 15{,}848/13{,}241 = 1.196$ True $H = 5{,}000{,}000 \times 1.196 = 5{,}980{,}000$ lb.

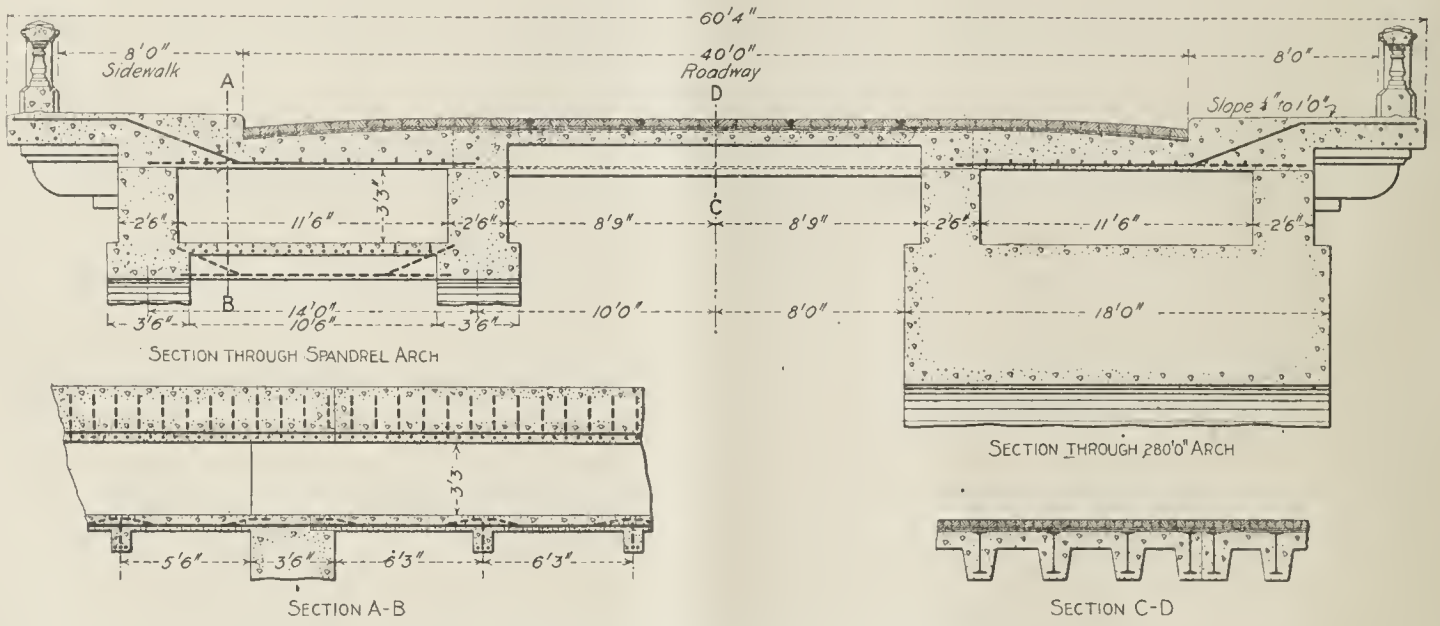
The abutments which carry these main arch ribs are founded on shale rock at a depth of about 24 ft. below the surface of the water in the river. Both ends of the pair of ribs are carried by a continuous abutment, which in both cases is of such size that the load on the shale does not exceed 6.5 tons per square foot. This is considered amply safe, as the piers of the existing bridge show that the bearing capacity of the shale is high. The thrust due to the arch is fully provided for at each end by the weight of the abutment and the tall pier carried by it, together with the backing of the shale bank.

The two abutments of the central arch are each surmounted by a heavy concrete pier, extending to the top of the structure and of sufficient size to give the proper architectural balance. On account of the size of the piers necessary to obtain this end, it was possible to make each of these piers in two halves and to connect these halves by a wall that gives the pier the appearance of being a single feature of the structure. Both halves of each pier are also hollow, since the volume of concrete is thus greatly reduced without diminishing the strength below fully safe limits.

The floor system of the roadway and sidewalks is carried for 50 ft. on both sides of the crown of the main arch by four spandrel walls, two on each of the arch ribs. Between both ends of these solid spandrel walls and the two piers of the main arch four 21 ft. spandrel arches are built upon both main arch ribs to carry the floor system. These spandrel arches each consist of two ribs with their piers connected by a curtain wall. The two ribs of each arch are also connected by a 6-in. reinforced-concrete slab that acts as a strut between them.

The approach spans are exactly similar in arrangement to the spandrel arches over the central span. Each of them consists of four ribs, built in pairs, with a solid pier carrying each pair. The pairs of ribs are also braced together with a 6-in. reinforced-concrete slab, as in the case of the spandrel arches. The ribs are three-centered arches, 3 ft. thick and 5 ft. wide at the springing lines and 2½ ft. thick and 4 ft. wide at the crown. They are reinforced over the extrados at both haunches, and at the intrados for 9 ft. on each side of the crown by six 1-in. bars.

One of the accompanying drawings shows the cross-section and details of the roadway and sidewalk floor system, and also section through the spandrel arch at the crown through the crown of the 280 ft. arch. As will be seen from this section, a subway, 3.25 ft. high by 11.5 ft. wide, is provided on both sides of the roadway for water, gas and sewer pipes and public-service wiring connections. The floor of each of these



The Roadway and Sidewalk Floor Systems.

subways is made by the 6-in. reinforced concrete slabs that act as struts between the pairs of ribs of the spandrel and approach arches. The roadway slab is reinforced over these subways with steel rods, but between the two main arch ribs it is carried by transverse 20 in. 65 lb. steel I-beams embedded in concrete. The 100 lb. T rails of the street car tracks will be attached directly to these beams. The latter are spaced 3 ft. 1½ in. apart on centers, except at the transverse expansion joints provided in the roadway at intervals of about 30 ft. where the two adjacent beams are 12 in. apart. The roadway is to be paved with brick laid on the concrete floor of the bridge. After the concrete is brought up to grade, three-ply tarred-felt waterproofing will be applied over it on the roadway. A 1-in. layer of sand will be placed on this course of waterproofing to re-

ceive the brick, which will have their joints filled with tar.

Three classes of concrete, beside the one in the main arch ribs, are used in the structure, all of these being made of Alma Portland Cement, sand and broken limestone. Class A, used in footing and foundations, is mixed in the proportion of 1 part cement, 3 parts sand and 5 parts broken stone. These portions of the structure are required to contain embedded pieces of limestone, with dimensions less than 1 x 2 x 3 ft., provided the pieces are completely surrounded by at least 3 in. of concrete. These embedded stones are deposited in the concrete as floaters, and wherever possible are worked into position after the concrete has been poured.

Class B concrete is made in the proportion of 1 part cement, 3 parts sand and 5 parts limestone, and is used in the piers and abutments above the neat line and in all of the spandrel walls. One-man stones are embedded in this class of concrete where feasible, none of these stones being permitted to come closer than 3 in. to the face, and each of them being surrounded by at least 3 in. of concrete.

The third class of concrete consists of 1 part cement, 2 parts sand and 4 parts limestone that will pass a 1-in. ring. This class is used in the roadways, sidewalks, brackets under the balustrades and the secondary arches.

All exterior surfaces of the concrete above the neat lines are to be covered with a mixture of 1 part Portland cement, 2 parts coarse sand and 2 parts granolithic grit, made into a stiff mortar. The granolithic grit is required to be of trap or granite rock crushed to pass a ¼-in. sieve, and with the dust screened out. For vertical surfaces the mixture will be deposited against the face forms to a thickness of at least 1 in. as the placing of the concrete proceeds, and thus form a part of the body of the work. The face forms will be removed as soon as the concrete has hardened sufficiently, and any voids that may appear will be filled with the mixture. The surface will then be washed immediately with water until the grit is exposed and rinsed clean. It will then be protected from the sun and kept moist for three days. For the horizontal surfaces the granolithic mixture will be deposited on the concrete to a thickness of at least 1½ in. immediately after the concrete has been leveled and before it has set. It will then be troweled to an even surface, and after it has set sufficiently hard, will be washed until the grit is exposed.

The centering for the main arch has been designed so that one rib may be constructed at a time. It consists trusses, spaced 23 ft. apart on centers essentially of two three-hinged steel and cross-braced together, that carry two lines of steel stringers on which the arch rib forms will be erected. The stringers of this centering consist largely of the beams that will afterwards be used in the floor system of the roadway. A bracket is being built on both the abutments to carry the shoes of the centering trusses, so the latter will be entirely independent of any falsework in the river. As it is considered impossible to construct more than one side of the main arch in a season, the danger of ice gorges forming in the river in the Spring required some such arrangement, in order that sufficient openings be left to permit the free passage of ice floes. The brackets on the two main arch abutments that carry the shoes of the centering truss are built the entire length of the abutments, in order that the centering may be moved to the second half of the arch without being dismantled after the first is completed.

The shoes of the trusses will be carried on heavy jacks to permit the centering to be lowered evenly and gradually under absolute control when it is to be struck. Each main arch ring is to be constructed in transverse sections in pairs, with the two sections of a pair in the same position in opposite sides of the transverse center line of the rib. The sections will also be of such dimensions that each pair can be built in the daylight of a single day.

The bridge was designed under the direction of Mr. A. B. Lea, engineer of Cuyahoga County, by Mr. A. M. Felgate, bridge engineer of that county. The contract for the construction was awarded to the Schillinger Brothers Co., of Columbus, O., and work on the abutments of the central arch is being carried ahead rapidly. Mr. Wilbur J. Watson is engineer for the contractors.

VALUABLE AND USEFUL BOOK FREE

"Aid to Shippers" is the title of a 72 page book containing a quantity of information of value to all engaged in the export or import trade. The book is issued by Oelrichs & Co., of New York, for more than forty years the American representatives of the North German Lloyd Steamship Company, who by reason of long experience are qualified to advise.

The table of foreign moneys with United States equivalents together with weights, measurements, tariffs, customs requirements etc., etc., will be found of great value.

"Aids to Shippers" will be sent, postpaid, on request to Oelrichs & Co., Forwarding Department, 5 Greenwich St., New York.

The Northwestern Concrete Products Association concrete exhibition held at Minneapolis on March 2, 3 and 4 was a great success, 89 exhibitors had space upon the floor at the Armory, the attendance was large.

The following officers of the Northwestern Cement Products association were elected at the annual business meeting: Martin T. Roche of St. Paul, president, re-elected; J. C. Van Doorn, Minneapolis, secretary, re-elected; J. M. Hazen, Minneapolis, treasurer, re-elected; Henry E. Murphy, Manitowoc, Wis.; Lee Stover, Watertown, S. D.; A. H. Laughlin, Lisbon, N. D., vice president, re-elected, and L. V. Thayer of Minneapolis and William Hurst of Glendive, Mont., elected vice presidents to succeed O. U. Miracle and C. A. P. Turner of Minneapolis.

William Scharfenburg is planning to operate his concrete block factory most of the winter at Traer, Ia.

CEMENT INDUSTRY IN CHILE.

A Chilean company namel El Melon, with a capital of £100,000 ($486,000), has established an extensive plant at Calera, a few miles from Valparaiso where there are large deposits of material from which first-class cement can be produced very cheaply. The capacity of the plant is 200,000 barrels per annum, which will about supply the normal demands of Chile. In 1906 the imports amounted to about 250,000 barrels, 1907, which was an abnormal year owing to the earthquake of August 16, 1906, reached about 480,000 barrels, while it is not likely the import statistics for 1908 will reach the 200,000-barrel mark.

The Kasmos Portland Cement Co., of Ky., is rebuilding its plant which was destroyed by fire. The new plant will have fire proof buildings and is to have a daily capacity of 1,600 barrels. The work will be done by The Freeborn Engineering and Construction Co., of Kansas City.

The Glens Falls Portland Cement Co., Glens Falls, N. Y., has passed into the control of the Alpha Portland Cement Co., of Easton, Pa., through the purchase of a majority of the stock.

IRONTON PORTLAND CEMENT CO.'S PLANT.

Among the well-known manufacturers of Portland cement is included the Ironton Portland Cement Co. of Ironton, Ohio, whose extensive plant is herewith illustrated. This plant is said to be with one exception the only one constructed on the gravity plan in the United States. While the power of gravitation is not depended upon entirely, it is an important factor in handling the raw products from reception up to shipment in manufactured form.

Besides being erected on a foundation that reaches from the base half way to the summit of what many communities would consider a mountain. the Ironton plant is peculiar, in that its products all come direct from the mines to the mill under operations controlled by the same power that grinds the shale and lime and coal. They enter the upper end of the mill in their native state and come out at the bottom as finished cement.

The company has several hundred acres underlaid with limestone, and the shale is found in adjoining strata. One hundred men are employed in the lime and shale banks, where electric drills are used along with an electric undercutter. The daily output is 300 tons of limestone and 60 tons of shale, which is carried from the depths of the mines to the mills by an electric tramway operating trains driven by an electric locomotive.

The limestone is dumped into a No. 5 Austin crusher, thence into a 5x40 rotary drier, then into Williams' swing-hammer mills, made by Williams' Crusher and Pulverizer Co., Chicago, which crush it down to 90 per cent on a 20 mesh for tube mill feed. Thence it is passed into large storage bins, and then ground in three 5x22 tube mills made by the Bonnot Co., Canton, Ohio, in connection with Emerick separators, to a fineness of 97 per cent on a 100 mesh. Then it passes into storage bins in the rear of four 100-foot rotary kilns. After passing through the kilns the clinker discharges into the rotary cooler and then into a fine crusher, which crushes it down to a three-quarter-inch clinker and finer. From there it is elevated to a vertical cooler, the material from which is then ground in four Kent mills, in connection with four Newaygo separators, to a fineness of 98 per cent on a 20 mesh. The product is then finished on three 5x22 tube mills, in connection with Emerick separators, to a fineness of 97 per cent on a 100 mesh, and from there it passes into a warehouse containing 12 bins with a total capacity of 40,000 barrels. Here it is weighed by automatic Richardson scales and packed by Bates valve bagging machines, which also weigh it 95 pounds to the sack. It is then loaded direct into cars from the packing-room.

Power is furnished by one 750-horse-power engine, direct connected with a 500-kilowatt generator and two 400-horse-power engines, belt connected to two 250-kilowatt generators. This furnishes electric power and lighting for the plant and mines. All machinery is electrically driven by independent motors.

The improved stitched canvas belting in this plant was furnished by the Sawyer Belting Company of Cleveland, Ohio.

The boiler-room is equipped with four batteries of water tube boilers, two of 350 horse-power and two of 450 horse-power each.

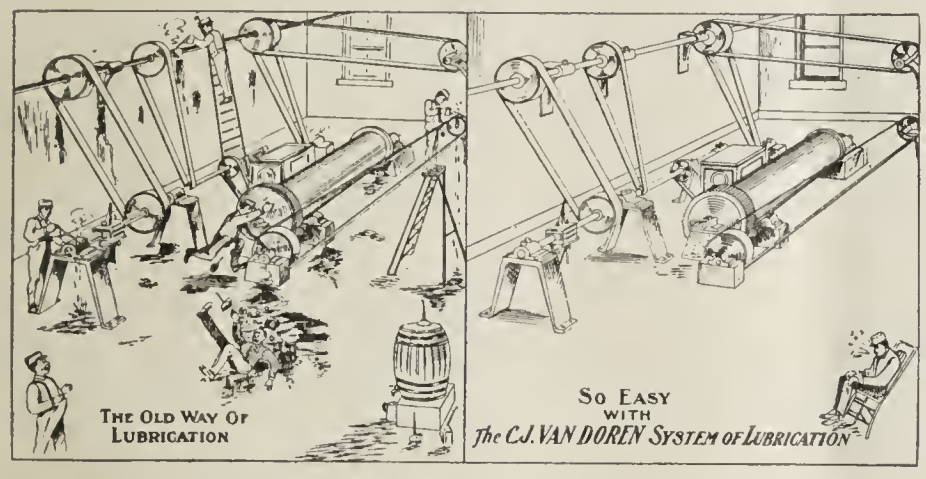
Natural gas is used for fuel, and it ensures uniform burning and color. The laboratory is equipped for examinations and tests incident to Portland cement production, and was equipped by E. H. Sargent & Co., of Chicago. First organized with $110,000 capital and building a plant for 400 barrels daily capacity, the company is now capitalized at $300,000 and manufactures 1,200 barrels of cement daily. S. B. Steece is president; F. C. Tomlinson, vice-president; J. R. Paul, secretary; A. C. Steece, treasurer and general manager; John A. Acker, superintendent; Guy La Forge, chemist.

Plant of the Ironton Portland Cement Company.

The Guthrie Mountain Cement Co.'s cement property near Mapleton Burbon Co., Kansas, has been released from taxes assessed for 1908, in order to help the company along in its projected enterprise.

THE VAN DOREN SYSTEM OF LUBRICATION.

The proper lubrication of machinery is one of the essentials of factory management. It reduces wear and tear by overcoming unnecessary friction and thus dispensing with waste of power, with this end in view. Mr. C. J. Van Doren, Supt. of the Ash Grove Lime & Cement Co., of Chanute, Kan., has placed upon the market a new and positive system of lubrication which supplies to the moving parts, at all time a continuous and perfectly regular automatic feed, without waste, while the machine is in operation. This device has been installed in a number of cement mills and pronounced to be an unqualified success. This device was invented by a practical cement expert primarily for cement mills, and is well worthy of examination, by those interested in cement manufacture. The device is



manufactured by the C. J. Van Doren Co., 5 West Madison street, Chicago.

A NEW COMPOSITE TYPE OF REINFORCED CONCRETE CONSTRUCTION.

John Cotter Pelton, architect of San Francisco, Cal., has designed a new type of building construction, which consists of a heavy wood framing, covered with four inches of concrete, anchored to the wooden framing. The wood taking the place of structural steel skeleton construction. The columns, beams and girders being insulated against fire by concrete, while the floors are composed of cement, cinders, and plaster of Paris in the form of slabs laid on joists, the curtain walls are composed of staff held in place by reinforcing rods. A building is being constructed of this type for the San Francisco underwriters, such a building can ordinarily be entered at less than a common brick structure at 15 per cent. more than ordinary buildings.

The use of steel reinforcing in the Plaster of Paris curtain walls, we believe to be an element of danger inasmuch of plaster of Paris carriers from 44 to over 46 per cent of sulphuric acid, which under high temperatures will be liberated and attack the steel reinforcing.

ARE OFFICIAL MATERIAL TESTING STATIONS BENEFICIAL TO INDUSTRIES.

A Writer in Kuhlow's German Trade Review, discusses this subject of official material testing stations and concludes that such testing stations are inclined to hamper industries. That the official machinery is not sufficiently alive and prompt to keep abreast of the improvements, the entire activity of such an institution being to observe, register and classify facts, with little or no initiative faculty, and are constantly seeking to place restrictions upon the freedom of movement of the various industries. In view of the proposed agreement with a state research Institution covering the mechanical, physical and chemical testing of certain materials. The experience of other trades in dealing with official testing stations have not been satisfactory. Nothing new has been acquired from such institutions, says one manufacturer, another states that they do not keep up to date, and are wonderfully behind the times in their recommendations and formulas, thereby causing injury to the trade.

REINFORCED CONCRETE IN 1863.

Reinforced concrete is not as new and modern as most people suppose. In 1863 a Mrs. Turner obtained a patent in England for a fire proof system of construction of bridges, roofs, floors and other structures, which consists of embedding of iron girders in ordinary concrete, so as to completely envelope them. This patent antidates the Monier patents by four years. The Turner System was quite extensively used in England, several illustrations are given in Totter's Treatise on concrete and its use in building construction. Published by E. & F. Spon, London, 1877.

The same book describes hollow concrete blocks with fluted ends, formed in molds by compression.

BUILDING OPERATIONS IN 1907-8.

The building operations in 63 of our leading cities suffered a decline of over seventy million dollars in 1908, as compared with 1907. The total value of building operation in these cities for 1907 was $656,067,969 as against $585,913,543 in 1908. The falling off in New York City was over fifteen million dollars in 1908, while Chicago gained over nine million in 1908, while Boston dropped from fifteen million in 1907 to eight million; Philadelphia declined from $38,659,655 to $28,408,580. The Western cities suffered less than the Eastern cities. The entire decline in building operations in 1908 was over 70 million dollars. Cities tributary to rich agricultural districts were least affected while those depending upon manufacturing showed the greatest decline.

Plans will be prepared at once by City Engineer A. F. Bannon, Jr., Bradford, Pa., for the construction of a modern sewage disposal plant and system for that city. This is in accordance with the instructions that have been issued by the Pennsylvania State Board of Health, which demands that this system be built in the immediate future on account of the unsanitary conditions there occasioned by the pollution of the streams. The plans will be submitted to the State Department, after which, if they are accepted, they will be turned over to the contractors and bids asked. It is probable that actual construction will be started by the middle of the present summer. There will be considerable concrete used in its construction, as the sedimentation basins will be constructed entirely of this material.

The Beaver Valley & Northwestern Railroad Company has been organized to build a line from Oklahoma City, northwest to Lajunta, Colo., about 500 miles. Surveys made and line located from Gage, Okla., where connection is to be made with the Atchison, Topeka, & Santa Fe, west via Beaver City to Hooker, where connection is to be made with the Chicago, Rock Island & Pacific, about 105 miles. Right-of-way secured for 80 per cent of the way and contract for construction let to T. E. Luttgerding, of Wichita, Kan., J. W. Webb, president, Beaver City, and C. H. Holmes, secretary, Gage, Okla.

The Atlas Portland Cement Co., is increasing the capacity of its kilns at one of its Hannibal plants.

DEATH OF EDWIN REYNOLDS.

Edwin Reynolds, one of the great mechanical engineers of the country, and for thirty years practical head of the Edward P. Allis Company, now the Allis-Chalmers Company, died at his residence, No. 446 Ivanhoe Place, Friday, February 19th, at 78 years of age.

For nearly three years Mr. Reynolds had been confined to his home; during the past year his death was expected at any time, and it was owing only to his remarkable vitality that he lived until now.

Edwin Reynolds, considered by many to have been one of the ablest mechanical engineers and designers in this country, was descended from a notable family which was among the first to cross the ocean and settle in Rhode Island. In this family was William Reynolds, who came from Gloucestershire, England, in 1673, settling in Rhode Island. Descended from him, in direct line, was Christopher Reynolds, who was born in Frenchtown, R. I., July 11, 1790. The latter, about 1810, moved to Mansfield, Conn., where he married Clarissa Huntington, and on March 23, 1831, Edwin was born.

The Late Edwin Reynolds.

Having received the usual education afforded by the public schools, Edwin became an apprentice to a small machinist in his native town. With his trade fairly learned he sought and secured work in machine shops in Connecticut, Massachusetts and Ohio. Later he went to Aurora, Ind., as superintendent of the machine shops of Steedman & Company, which was largely engaged in the building of engines, saw mills and drainage pumps for Mississippi plantations. At the outbreak of the war between the states, Mr. Reynolds returned to Connecticut, and for six years he was active in his trade in that state and in Boston and New York, during which time he worked upon the machinery of Erickson's "Monitor," which played such an important part in the Civil War. He then went to Providence, R. I., entering the shops of the Corliss Steam Engine Company. In 1871 he was made general superintendent of the plant, remaining until 1877, when, at the earnest solicitation of the late Edward P. Allis, he resigned to engage with Edward P. Allis & Company at Milwaukee.

MINE RESERVE STATION.

A Branch station for instruction in general mine reserve work has been installed in the mechanical laboratory of the College of Engineering of The University of Illinois at Urbana, Ills. Jointly by the U. S. Geological Surveys Technological Branch and the Illinois Geological Survey, to be devoted to instructions in general mine rescue work and for investigations of mine accidents in Illinois, Indiana, Western Kentucky, Iowa, Missouri and Michigan.

A gas tight room fitted up to resemble a mine to a certain extent, into which poisonous gases are introduced. Men enter this poisonous atmosphere wearing oxygen helmets, can enter this room and perform work similar to that required after a mine explosion, or in fighting mine fires, all of the tools used in mine rescue operations form part of this laboratory equipment, such as oxygen helmets, oxygen resuscitation cases, used to revive men who have been overcome by mine gases.

The reports of mine investigations and the cause of explosions or other accidents are strictly confidential. The reserve station is open to the public on Saturday of each week when public exhibitions, the balance of the week being devoted to the systematic training in the use of oxygen helmets.

R. Y. Williams, mining engineer, U. S. Geological survey will be in charge, all correspondence regarding this station should be addressed to Mining Engineer, U. S. Geological Survey, Urbana, Ills.

A Cement for Resisting Sea Water was described in a recent issue of the "Journal" of the Society of Chemical Industry by Mr. C. J. Potter. It is made by grinding six parts by weight of calcined red brick clay with ten parts of Portland cement clinker, and is known as "red cement." Tests of briquettes immersed in fresh and sea water for periods up to 10 years show, Mr. Potter states, that while Portland cement decreases in strength in sea water, red cement, on the other hand, increases in strength. Both red and Portland cement increase in strength in fresh water, the latter in the larger ratio. Over 5,000 tons of red cement have already been used in sea and fresh water, and the results are said by Mr. Potter to be satisfactory.

Joseph A. Hoffman, of Mill Valley, Calif., has patented a new form or shape of brick, to be reinforced after the manner of reinforced concrete, with iron straps, rods or bands of wire. The bricks or blocks have grooves or perforations, or both. The perforations go through the narrow way of the brick and extend half through the width. The grooves go lengthwise or crosswise, so that the reinforcement may rest therein. They permit reinforcement vertical and horizontal. The intention is to attach the various sections of reinforcement to one another by means of welding eyes or perforations, and the top is to be anchored or riveted through a plate of steel or iron. Mr. Hoffman claims that all of the advantages of reinforced concrete construction are gained by this method, without the labor and expense of wooden forms, and that the greater strength of the reinforced brick construction will permit of brick walls being at least one brick thinner than under the present method of building, thereby saving expense.

The Ohio Association of Contractors has elected the following officers: President, Oliver Riley, Cleveland; vice-president, William H. Graham, Columbus; trustees, J. E. Conley, Dayton; William Wildes, Akron; L. A. Fauver, Elyria; W. H. Adams, Zanesville; W. H. Luchtenburg, Columbus; E. A. Kelly, Portsmouth; Thomas Mulligan, Lima. The association will establish permanent headquarters in Columbus.

THE KNICKERBOCKER PORTLAND CEMENT CO.'S PROJECT.

The United States Cement industry is passing into strong, hands and conservative management. The days of wild promotion by inexperienced and unprincipaled promotors is about over. Capital is becoming cautious in the purchase of cement securities without first making a thorough investigation of the claims advanced in the cement promotion projects.

The Knickerbocker Portland Cement Co.'s project is one that will bear the most careful scrutiny, as a safe and sound proposition from every point of view; starting out with a New York charter which is evidence of fair dealing. The capital stock is placed at $6,500,000, of which $2.500,000 is preferred and $4,000,000 common. The Company controls about 500 acres of land carrying strictly first class limestone, clay and shale deposits on the East bank of the Hudson River, Hudson, N. Y., and a similar tract on the opposite banks of the river, with practically the same class of material; the available raw cement materials in these tracts being sufficient to produce several hundred million barrels of strictly high grade portland cement. This location will enable the Company to reach the New England market by rail at 7 cts. per barrel less than cement originating west of the Hudson River including the great Lehigh cement districts. An all water rate from the Company's docks at Hudson, N. Y., to New York City, will be less than 10 cts. per barrel laid down at any point on the docks of that City; against a rate from the Lehigh Cement district of not less than 16 cts. per barrel to Jersey City, with an additional charge for litharge of 40 cts. per ton from the New Jersey shore points in New York harbor, or 24 cts. per barrel from the Lehigh cement district to destination of docks in New York City. The same advantage is to be obtained in all water hauls from the company's docks to the Atlantic coast ports, especially to New England points, in unbroken cargo lots for all vessels of 22 feet draft or less, giving the Knickerbocker Co., exceptional advantages for entering the Atlantic Coast market, and at the same time, its fuel supplies can be delivered at its own docks in cargo lots, with minimum freight charges less than any independent rail hauls.

The Company's plant is to be located on the sloping side of a range of hills just below its quarries, so as to receive the material rock, clay and shale by gravity, to and through its mills, which insures an economic operation of its plant. The officers of the Company are experienced cement manufacturers, of the first order. Mr. Sheldon H. Bassett, President of the Knickerbocker Portland Cement Co., is one of the most successful cement manufacturing experts in the country. At once careful, conscientious and untiring in his devotion to the interest of the stockholders, producing large dividends by honest and efficient management. As President of the Iola Portland Cement Co., he never missed a dividend, and enhanced the value of the securities, tenfold. Purchased new plants out of the earnings, increased the capacity of the original plant from 1500 bbls. daily capacity to over 6000 bbls. per day. During his management the Iola Cement Co., purchased the Texas Portland Cement plant of 1500 bbls. per day, and built a new plant of 4000 per day at Dallas, Texas. Mr. Bassett was the highest salaried officer in the United States Cement industry. The Knickerbocker Co., is most fortunate in securing his services. The trust committed to his hands will be well and faithfully administered upon sound practical business principles, with the best interest of the stockholders always uppermost.

THE CEMENT PRODUCTS SHOW.

The unqualified success of the Chicago Cement show at the Coliseum Feb. 18 to 24 was the event of the year, in the concrete industry. Nothing of the kind has ever been seen before. It was a success beyond the wildest dreams of its promotors, with 202 exhibits, every inch of floor space was taken on the main floor of the great Coliseum building as well as the large annex. Every tool implement and device used in the manipulation of concrete and its products were to be found in orderly array along the numerous aisles, including cement shingles and shingle making machinery, cement blocks and machinery for their production concrete tamping machinery, cement tile and pipe and the wonderful machinery upon which these tile were formed. This class of machinery was always the center of great interest, being one of the novelties of the season. Concrete forms for producing Monolith walls, as well as double walls were well represented, concrete reinforced post and forms in which they are produced were numerous, water proofing compounds under various names were displayed and their merits expounded by experts. Methods for constructing walls on the ground with door and window openings for two story buildings. Such concrete walls being raised from the horizontal to the perpendicular were shown. This form of concrete building construction was one of the numerous novel features of the show, and represented a new era in concrete building construction, highly finished stationary wash tubs, attracted the attention of the ladies. A new form of concrete building construction, in which the walls were built up without the use of forms, other than that forming a part of the finished structure, with an inside air space between the outside wall and the plaster coat. This system, it is said, can be erected cheaper than wood construction. Steel reinforcing members used in reinforced concrete were shown, assembled for columns, beams and floors, as well as the unassembled steel reinforcing members. Several of the leading cement companies, had their booths elaborately installed with high grade and finished concrete work executed by first class artists, which showed the possibilities of concrete as a decorative material in competition with carved stone work, in this respect the Atlas Portland Cement Company, the Chicago Portland Cement Co., the Marquette Cement Manufacturing Co., The Sandusky Portland Cement Co., and the German American Cement Co., deserve special mention as well as the Vulcanite Portland Cement Co., represented by Geo. DeSmet. The Cement and Concrete Mixing Machinery Exhibits were more numerous than at any previous cement show. The attendance of paid visitors, was simply phenomenal, and broke the record on the first day, with the largest attendance of all of the shows ever held at the Coliseum, excepting only the Ringling Circus. The business done by the exhibitors were so satisfactory that many of these exhibitors freely expressed their opinions, that there should be only one cement show in the west, and that one at Chicago, with another show at New York City, because visitors can always obtain reduced railway rates to and from Chicago, and that the same will be true of New York city, while the business done at Chicago is always satisfactory which is not true of expositions of cement products in smaller towns. The space for the next Chicago cement show spoken for by the concrete industry will require all of the additional space in the galleries of the Coliseum which will increase the display room by one third over the space used at the February show. In the light of passing events, we feel warranted in saying that every one must now concede that Chicago is the great and only show town for concrete and allied industries in this country.

IMMENSE CRUSHING PLANT.

The Brownell Improvement Company's Operations and Quarry at Thornton, Ill.

On the Chicago Terminal Transfer and the Chicago and Eastern Illinois Railroads, at Thornton, Ill., is located the immense crushed stone plant and quarry of the Brownell Improvement Company, whose offices are in the Chamber of Commerce Building, Chicago. This quarry has been in continuous operation for twenty-one years and the enormous quantity of crushed stone that it has furnished to Chicago and its vicinity and the many railroads in the State of Illinois is simply incalculable. About 50 per cent of their entire output is consumed by the railroads, the Brownell Improvement Company having been identified with this class of work for many years. They are one of the most extensive contractors in railroad construction in all the West and use annually about 400,000 cubic yards in this manner alone. The Chicago, Rock Island and Pacific Railway, the Lake Shore and Michigan Southern and many other railroads, for years have secured all their ballest from them. Their holdings cover more than 500 acres, all underlined with limestone, and core drillings have been made to 2,100 feet. After twenty-one years' continued activity, the depth of the quarry is only about eighty-five feet and the supply can be truly said to be inexhaustible. Being only about twenty miles from Chicago, with its transportation facilities of the best, its ease of access, the short time required to deliver the product, not only to Chicago but all over the State, and the greatly increasing demand for crushed stone, a demand that is increasing in leaps and bounds each year, as the many uses to which such material can be put is constantly being learned, this property is indeed a valuable one.

Not many years ago, they opened up a new section in their quarry. This section is now twenty-six feet deep, with a face of 6,500 feet. It is of stratified limestone and of the very best quality.

We give an illustration of one corner of this new section, from which one may form rather an accurate idea of its appearance. Drilling, as yet, is done to the entire depth of the quarry, and after blasting and loading the material into cars with their immense new Buycrus, it is elevated by cable and hauled by locomotive to the crushing house, where it is automatically dumped into bins, each bin having a capacity of 1,000 cubic yards. They use nine crushers, five Gates, numbers 9, 8, 6, 5, 4, and four Austins, numbers 8, 6, 5, 4, and have just placed an order with the Power and Mining Machinery Co., of Cudahy, Wis., for a No. 10 McCully Crusher and a No. 6 McCully Crusher. All drilling is done by air, the Ingersoll-Rand Company's drills being used exclusively. A ninety-five ton Bucyrus shovel, known as 1073, is used, and Mr. Hodgkins states that the work it performs is marvelous. While speaking of this shovel we might mention that Colonel Hodgkins is a pioneer in utilizing the possibilities of the steam shovel in excavation and quarry work, and while now he has many imitators, he holds the honor of being among the first to adopt the idea. Almost twenty years ago, Mr. Hodgkins says, he first introduced a Bucyrus, a forty-five-ton affair, known as No. 174 (of the Thompson type), and while it is now somewhat antiquated in appearance, it is still capable of performing mighty good work. Both Gates and Austin screens are used, which separate the crushed rock into nine different sizes, the larger sizes being used for macadam and the smaller for concrete.

The Chicago Terminal Transfer and the Chicago and Eastern Illinois Railroads have tracks on either side of their plant, with switches running directly under the storage bins, which are emptied into the cars by gravity. With these transportation facilities there is scarcely any section of the country within hundreds of miles that is not a natural tributary for them. Michigan, Indiana and Illinois can all be supplied at the lowest possible freight rate, and Mr. Hodgkins states that their business in these sections is increasing rapidly. Chicago nevertheless is their principal market and consumes such great quantities of their product that they have not been able to give this outside territory the attention that it deserves.

Col. Jefferson Hodgkins, the president of the Brownell Improvement

View of the 95-ton Bucyrus Steam Shovel in operation at the plant of the Brownell Crushed Stone Company.

Company, is thoroughly acquainted with every detail connected with his business, and is truly a practical man in every sense of the word. He and the interests he represents have become so identified with construction work, more especially railroad construction, that when speaking of this work one naturally thinks of Colonel Hodgkins or the Brownell Improvement Company.

COMPULSORY CONSTRUCTION OF CONCRETE BRIDGE.

The Senate of the State of Kansas has passed the Hodges bill which provides, that County Boards must build concrete or stone bridges in the State of Kansas where such concrete or stone bridges do not cost over 30 per cent more than steel bridges. Senator Hodges stated in speech in support of this bill that stone or concrete bridges would last more than twice as long as steel bridges and would in the long run be cheaper, and at the same time would break up the bridge trust now operating in Kansas.

THE NEW HURON PORTLAND CEMENT MILL AT ALPENA MICH.

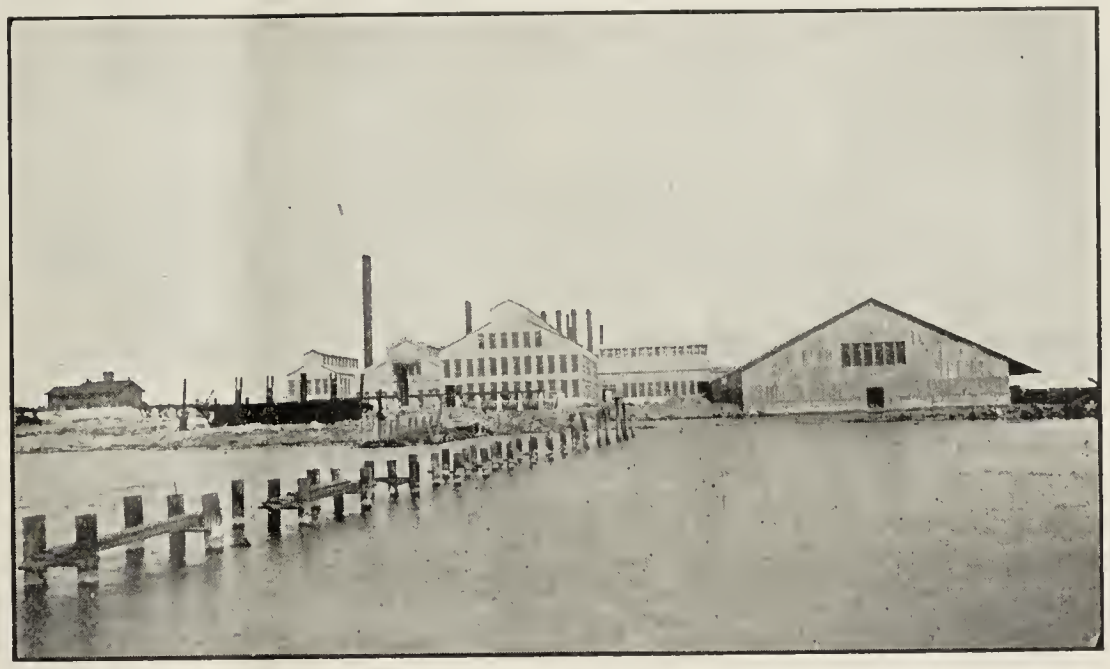
In the summer of 1907 another cement mill was opened in the State of Michigan, The Huron Portland Cement Company's mill at Alpena, which will heavily increase Michigan's total production of cement and will have the effect of bringing this state back to third place in the ranks of cement producers, and may possibly advance her to second place, as this mill has a daily production of 3,500 barrels, making it the heaviest producer in the State of Michigan.

A visit to the plant indicates that every expectation of the projectors of this new enterprise will be fully met. The buildings are firmly and solidly constructed, the most modern styles of cement-making machinery is installed, and every possible device that will save time and labor is employed.

There are several advantages in the location of the plant. Being on the shore of Thunder Bay, an arm of Lake Huron, the company is in a position to receive its coal by boat in its own slip, and to make shipments by water. Good rail connection also provides facilities for land shipments.

Altogether, the plant covers about ten acres, including sidetracks, slip, etc. There is practically an inexhaustible supply of limestone and shale close at hand, giving assurance that the best quality of Portland cement may be turned out in the most economical way. Special elevated tracks have been installed for hauling each kind of material to the plant. One is used to haul coal to the pulverizing room, where three Raymond mills reduces the fuel to powder. Another track carries coal to the boiler room; a third is used for carrying stone to the nine Raymond crushers, and a fourth elevated track is used to bring shale to the plant. Underneath the shale and coal tracks there are concrete tunnels, so constructed that when the material is dumped it falls on each side of the tunnels and thence through chutes upon conveyors and into the mill proper.

The main building is 110′ x 320′, and contain six kilns, 110′ x 8′ manufactured by The Bonnot Company, Canton, Ohio. The cement is ground in 14 Kent mills, after which it is stored in a building 360′ x 160′. This structure, which is made of timber



The New Huron Portland Cement Mill.

cribbing, is divided into large bins, and holds 365,000 barrels. The Sawyer Belting Company, Cleveland, O., furnished the canvas belting for the entire plant.

In the boiler room are five boilers of 400 H. P. each. The engine room contains three Corliss engines of 800 H. P. each, manufactured by the Murray Iron Works, Burlington, Iowa. Besides these there is two Skinner engines operating 125 and 250 kilowatt generators.

An interesting feature of the plant is the slip which is 800′ long by 104′ wide, with a depth of 18 feet, so that large vessels may enter. In order to reach deep water it was necessary to dredge through rock, and this proved a tremendous job. The sides of the slip is protected by a heavy concrete sea wall. From this slip cement is shipped to the Huron Co.'s large warehouses and shipping docks at Detroit, Cleveland, Milwaukee and Duluth. All foundation work on the plant is made of monolithic concrete, in which Wyandotte Portland cement was used; the superstructure is of structural steel. The roofs are of corrugated iron.

Construction on the plant was begun in April, 1906 and it took a year to complete it.

The Officers of the company are as follows: President, J. B. Ford; vice-president, E. L. Ford; secretary and treasurer, S. T. Crapo; general manager, H. J. Paxton. These officers will make up the board of directors, together with the following: B. F. Berry, George B. Morley and George R. Ford. J. W. Frederick is superintendent. The capital stock is $1,200,000, all of which was used in the construction of the plant and for working capital.

The principal officers of the Huron Co are also identified with the Wyandotte Portland Cement Co., and the undoubted success of the latter, the strong financial condition of the stockholders, as well as the advantageous location of the plant, give the greatest indication that the new company will be one of the strongest cement producers of the country.

The Fostoria Concrete Products Company has been incorporated at Fostoria, Ohio, with a capital stock of $5,000. The incorporators are John S., Amy N., S. A. and Oscar V. Maurer and Josiah Noble.

The Concrete Products Company has been incorporated in New York City for concrete construction work. The capital stock is $1,000,000. The incorporators are R. F. Tucker, G. H. Guy, New York; K. L. Martin, Brooklyn; P. A. Tomes, Woodmere, L. I.; M. Watson, East Orange.

Asotin, Wash.—The Portland Cement Co. is, according to press reports, rushing work on the construction of the cement plant on the upper Snake River.

A COMPARISON OF BRIDGE WATERWAYS.

In a recent design for a concrete bridge of several spans the suggestion was made to the engineer that a camber of two or three feet which would elevate the roadway and crown of the main span slightly and would enhance the appearance of the structure. The engineer, who was one of the old-fashioned, over-practical kind, replied that he had never observed the water in

Properly Designed Arch with Low Springings.

that particular river to have such a camber, and he could, therefore, see no reason for it in the bridge. He required, therefore, that the roadway should be level throughout its entire length on the bridge, while the approaches fell abruptly to a much lower level. This engineer was mistaken in his first assumption, for the surface of a river is curved, although in falling floods it may be concave upwards, the reverse of what is desirable for a graceful camber in a bridge.

But his attitude is typical in many ways of the preference that many engineers have for a straight girder bridge, who give as a reason for their preference the argument that the girder bridge has a great advantage in waterway over other forms. Similarly, in the erection of arch bridges, it is quite the usual thing to find an engineer insisting on arches with high springings, in order to increase the waterway. It is believed that a comparison of waterways will show the above ideas to be fallacious, more especially for concrete bridges.

Let us, for convenience in comparison, assume that all waterways are divided into the three classes shown by Figs 1, 2 and 3, the rectangular form in Fig. 1 representing the usual opening for girder bridges, the V form of Fig. 2 representing the general type of opening converging at the bottom of which a usual form is the egg-shaped sewer, and the A form of Fig. 3, representing the type converging at the top, of which the arch is the most usual form. Let us assume, also, for purposes of comparison, that the areas of the three waterways are equal.

In attempting to determine which of these three forms is the most efficient three principal features may be compared: the efficiency of the structure required to span the opening, capacity for discharge of water and capacity for discharging ice and floating debris.

It is apparent at a glance that the structure required to span the V form of opening of Fig. 2 will be less efficient than that required to span the same area of waterway in Fig. 1, having the rectangular opening, for the span is greater. The A form of Fig. 3 also requires a longer span than Fig. 1, but in this case the disadvantage of longer span is offset by the greater efficiency of the type of structure that may be used to span the opening. It will be noted at a glance that the structure spanning Fig. 3 is of a stronger type than that sanning Fig. 1. An opening of the A type in Fig. 3 even proves self-supporting at times in stiff clay soils, without any supporting structure, whereas the girer type of Fig. 1 would never do so. In reinforced concrete especially, the arch has a decided advantage over the girder in that a much greater percentage of its material may be subjected to comparatively uniform and high unit stresses. A steel beam or girder is a comparatively efficient under stress and doing work. And the steel girder has advantages in fabrication and erection that can not be approached by the steel arch except for the longest spans. But in reinforced concrete an entirely different relation exists. Concrete is effective in compression only, so that all concrete below the neutral axis is waste material in so far as sustaining stress and doing work in supporting loads is concerned. Above the neutral axis the stress ranges from zero to the maximum allowable stress, so that but one-half of that half of the girder is employed at its greatest possible efficiency. And these conditions again range from maximum stresses at the middle of the span to a minimum near the supports. It is safe to say, then, that upwards of three-quarters of the concrete in a girder is useless in supporting loads, and therefore does no work except to protect the embedded steel, and that if the concrete could be so placed as to subject all of it to its maximum allowable stress less than one-fourth of the concrete required in a rectangular girder under present conditions would be sufficient to sustain all stresses.

In the concrete archh quite a different condition exists. The region of compression, which in the beam was limited to the upper half only, is extended in the arch by reason of the thrust, so that the entire area of the arch ring may be in compression, and in certain parts in uniform compression, which, of course, is the ideal condition from the standpoint

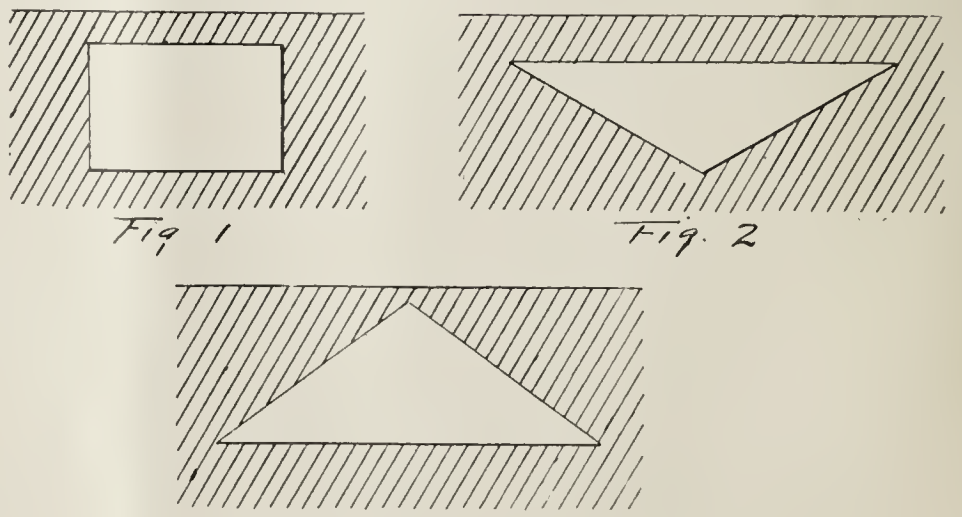


Fig. 3.

of efficiency. If the arch curve be chosen to be in equilibrium under the fixed load alone, and no moving loads applied, the entire arch ring ring would be in uniform compression and with no waste material whatever, a condition that has no parallel in the case of a beam, whether of concrete or steel. While tension may occur in the arch due to moving

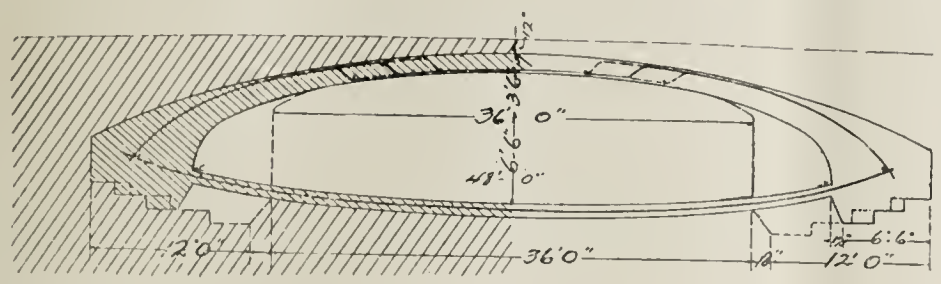


Fig. 4.

loads, the regions of tension are much more limited than in the girder and the degree of tension much more restricted. In consequence a much larger percentage of the concrete employed in the arch is useful in resisting stress and in supporting loads.

The arch, moreover, is, in the very nature of its form, the more efficient structure of the two, for it takes advantage of the passive resistance of the embankments and abutments against lateral displacement, while the girder bridge must actually overcome the active pressure of the embankment, to no useful purpose. The difference in efficiency of these two types of structures is well illustrated in their application to long spans. No designer would employ a concrete girder for spans of 150 feet, although such a design would be quite feasible except for economic considerations. But arch spans of 150 feet are not at all unusual. Where, then, is the modifying condition that causes the grder to become more efficient than the archh for short spans, when it assuredly is not for long spans? Apparently the condition that can produce such a result must be sought not in their relations as to amounts of material required, but rather in the cost of forms and placing of materials. And as these two items do not often exceed 10 per cent of the cost for each, there is not a great opportunity for a showing of efficiency in these two factors, and only for the shortest spans, say up to offset tdhe decreased material required for the arch.

It is not unusual to see on some of our railroads twin span box culverts under heavy fills, the designer actually blocking the waterway with a pier in order to support his ineffective slab under such conditions. A further error of judgment is frequently made in such cases by the designer who computes the beam on the assumption that part of the earth loading is self-supporting, due to arching of earth fill, whereas there can be but little doubt that the entire fill of earth vertically above the beam rests its weight upon the slab. The arch of single span, instead of the twin span beam culvert is the logical structure under such conditions, and for quite as simple reasons as that a square peg will not fit a round hole.

In comparing these openings for efficiency of discharge of water the V form of Fig. 2 is, of course, to be preferred for continuous water courses, such as sewers or conduits, because its hydraulic radius is a minimum for shallow flow, thus insuring maximum velocity and discharge. But when such an opening constricts a water course, as is usually the case in bridge openings, quite a different condition exists. The opening should be designed to avoid obstructing the stream and to prevent damming up of the current, especially in times of flood. It might be assumed off-hand that the V-shaped opening would be favorable for flood discharge, because as the water rises the span becomes greater. But in reality this V form of opening must first retard the flow of water and force it to a flood level before it provides for a flood discharge. It is the one form of the three that certainly does obstruct the channel in floods. Where the general bed of the stream is broader and flatter than the opening itself, as would almost invariably be the case in bridges, such an opening as the V form can not provide flood discharge without damming the current, the very feature that we desire most to avoid.

For quite similar reasons the A form is more effective than the rectangle. Considering discharge of water alone, the A form is without question the most effective of the three, since its center of pressure is lowest, and it consequently discharges under greatest head for any given water level. Assume, for example, that an outlet be cut through a dam to release the contained water; the A form of opening will, of course, release obstructions; debris may remain floating above the opening and be unable to find an escape as long as the flood rises, but will do no harm unless it becomes so excessive as to cause a jam. It is, however, rare indeed that the water is backed up by an opening except in small culverts, provided the crown of the arch is above normal high water. For a backing up of the flood of one or two inches on the upstream side of the arch results in a head that increases the velocity and consequently discharge by 10 to 20 per cent. A jam against an arch usually breaks as the water falls and passes away with the receding flood. The tendency for drift to lodge in the corners at the springing is easily counteracted by using an oval curve of the five-centered or seven-centered type.

Fields of ice are most readily broken up by being forced the water most rapidly, and the higher the water level the more marked will be its advantage. Acting in exactly the same way in floods, this form would provide maximum flood capacity as a bridge opening. The fact that the stream may flow full below the brige as well as above has no bearing, for this will be true only so long as the brige opening oes not obstruct the stream. The moment that the waterway becomes an obstruction a head is formed and the case becomes parallel to that of the dam cited above.

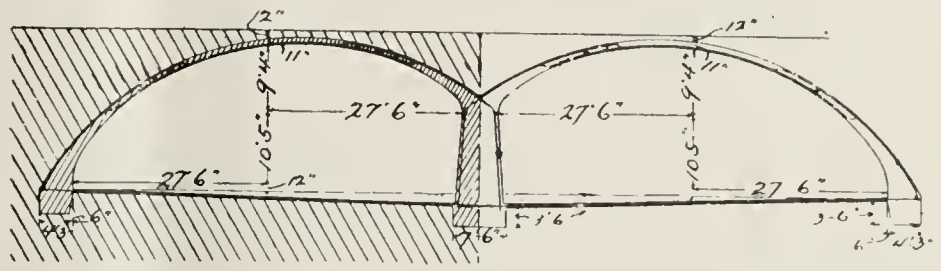


Fig. 5.

The V form of Fig. 2 and the rectangular opening of Fig. 1 have, therefore, no advantage for flood discharge only, and the A form of Fig. 3 or the similar arch forms will discharge the greatest volume of water for the same area of waterway.

The question of behavior of ice and debris in floods is an extremely difficult one to deal with, because it assumes such varied forms that it is

almost impossible to reduce it to any law. Debris and ice run with the current on a rising flood, but lodge at the sides as the flood falls. The V form of opening might seem to have an advantage in that it clears itself of debris in a rising floor, but with a receding floor the debris lodges and clings to the sides of the opening, leaving it at all times littered and obstructed until the next flood carries it away and leaves a new deposit.

The rectangular opening of Fig. 1 has an advantage in that rise or fall of water level does not result in lodgment of debris. This form is obstructed by floating logs so large as to span the entire opening and lodging against both abutments, by trees with tops too large to pass under the span and by drift against the abltments stranded by falling flood evel. The arch form will be obstructed by these same conditions, but with this advantage that a fall in the flood level will tend to dislodge drift rather than to permit it to lodge, as in the V form of opening. And there is not a corresponding tendency in the arch for floating debris to lodge against the arch with rising flood, as might be anticipated, because the suction of the current deflected downwards into the opening tends constantly to force it down and through the opening. Any tendency of the drift to pile up against the structure produces the same result, for its increasing weight crows it downwards to a point where the increase in span permits it to escape. An arch opening may even be completely submerged without danger of by the current upon inclined ice breakers, causing them to slide upwards on the breaker and break of their own weight and the pressure of the current. The rectangular opening has no advantage in handling ice and must receive its impact with full force. The arch is better adapted to discharging ice than the rectangular waterway, since the downward tendency of the current at the opening tends to exaggerate the effect of the ice breakers in breaking up a field of ice moving with the current. A more important advantage, and one that the arch bridge has over every other form of bridge, is the greater weight of the arch structure enabling it to better resist jams of ice and debris once they have actually formed.

It should be obvious, therefore, that unless a material increase in waterway results there is no advantage in elevating the springings of an arch. And if all that is desired is increased waterwaf this is much better secured in other ways in a single arch structure. Thus, in Fig. 4 is shown in dotted outline the abutments for a 36-foot span with high springings, and in the same figure in full lines is shown a 48-foot span low springings, the arch rings being coincident. The waterway of the 48-foot span is, of course, greater than that of the 36-foot span, yet the material required for the structure is less by the amount saved in the abutments. Here, then, is an increase of waterway with decrease of material and decreased cost. And the waterway of the longer span is not only increased but is arranged in a better form to provide efficient discharge. It is rarely if ever economical in a single span arch to increase waterway by raising sprngings; increasing the span is much the more economical method.

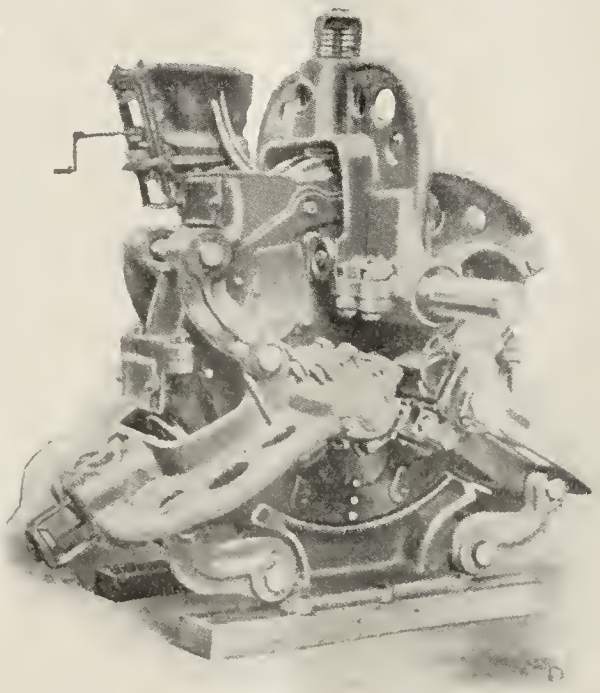
(Presented by Daniel B. Luten before the Indiana Engineering Socety.)

THE MAXECON MILL.

The new Maxecon mill for pulverizing in cement plants is shown herewith. This machine is manufactured by the Kent Mill Company, 170 Broadway, New York, and was exhibited at the recent cement show in Chicago. Everybody was impressed with it, and the genial Mr. Kimball was on hand to answer all inquiries.

The Kent mills were installed in the Chicago Portland Cement plant at Oglesby, Ill., which was described in our last issue, and also being used in the Ironton Portland Cement mill at Ironton, Ohio, and also the new Huron Portland cement mill at Alpena, Mich., and the management of these plants are highly pleased with them.

The two latter cement plants are described and illustrated in this issue.



Regarding the Maxecon mill they have the following to say: "Experience during the last ten years in constructing and observing the Kent mill has made it possible to evolve a pulverizer which embodies the perfection of the Kent principle of grinding. This latest type of pulverizer may be operated with fewer stops, less than one-third the repairs, and less than one-half the horse-power per unit of output, of any pulverizer of other principle in existence.

This pulverizer, because of these superior qualities, coupled with its comparative output, has been named the "Maxecon Mill," derived from "Maximum Economy" in all that goes to make up the cost of running a grinder. It is substantial and compact and is constructed and operates on the basic principle of a free vertical concave ring, yieldingly supported on three rolls pressing against its inner face and having a free movement relative to each other.

The lateral freedom of the ring, allows it to adapt its position relatively to the material being ground, so that the line of least resistance to crushing of the material is at once attained and the crushing is accomplished with the minimum of wear and power.

The ring revolves and the three rolls press against its inner face. These are the four wearing parts. The rolls are convex, and the ring is concave and tracks on the rolls.

The spring supports the rolls yieldingly and the rolls support the ring, so that the four crushing parts are free to move to pass iron or uncrushable objects, and are cushioned to take up shock and vibration and prevent crystallization or breakage.

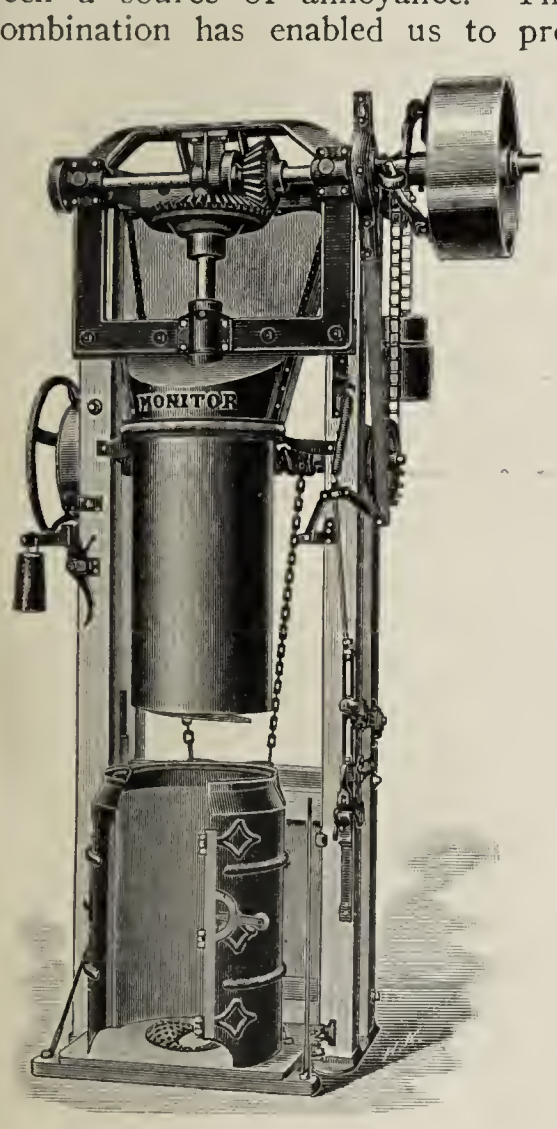
The feed falls onto the inner face of the ring. Centrifugal force holds it there in a layer an inch deep. It revolves with the ring, and passes under the rolls. The rolls are pressed by the springs outwardly against the material on the ring with a crushing pressure, adjustable by the screws to 20,000 pounds. The rolls roll over the material, crushing it against the ring. The crushed material flows off each side of the ring into the casing and falls to the discharge.

The body of material between the rolls and the ring makes most of the material abrade on itself in crushing, thus reducing the wear on the wearing parts to a small percentage of that on any other pulverizer.

The Russia Cement Co., of Gloucester, Mass., has opened its plant at Anacortes, Wash., work on which began in July, 1907.

THE MONITOR CEMENT PACKER.

The Huntley Manufacturing Company, of Silver Creek, N. Y., manufacturers of the Monitor iron front friction clutch packer, had their machine on exhibition at the recent Chicago cement show, and it attracted many of the visitors. This machine, a cut of which we present herewith, is specially constructed for packing cement, plaster of Paris, dry paint, talc and all kinds of pulverized minerals and other material. They have the following to say regarding their packer: "In the construction of the Monitor Iron Front Friction Clutch Packer we have of course, utilized many of the old and well known principles used in all packers, and have added thereto many new and important features original with ourselves, and discarded parts that have always been a source of annoyance. This combination has enabled us to pro-



duce a machine that has only to be tried to convince the most skeptical as to its merits.

"This Packer is very strong in construction. Built with a cast iron front. The driving shaft is 2¼ inch in diameter and is supported by a bearing on both sides of the Packer, giving it a rigid support and insures gears always being in perfect mesh.

"Another important feature not found in other similar packers, is that this Packer can be made to drive on right or left side facing the packer, and use right hand augers, as the bevel pinion can be changed from one side to the other, always driving auger shaft in the same direction, whether the driving shaft runs over or under. This enables you to change position of Packer without changing augers or crossing belts. When ordering a Packer take this in consideration."

A NEW LINE OF AIR COMPRESSORS.

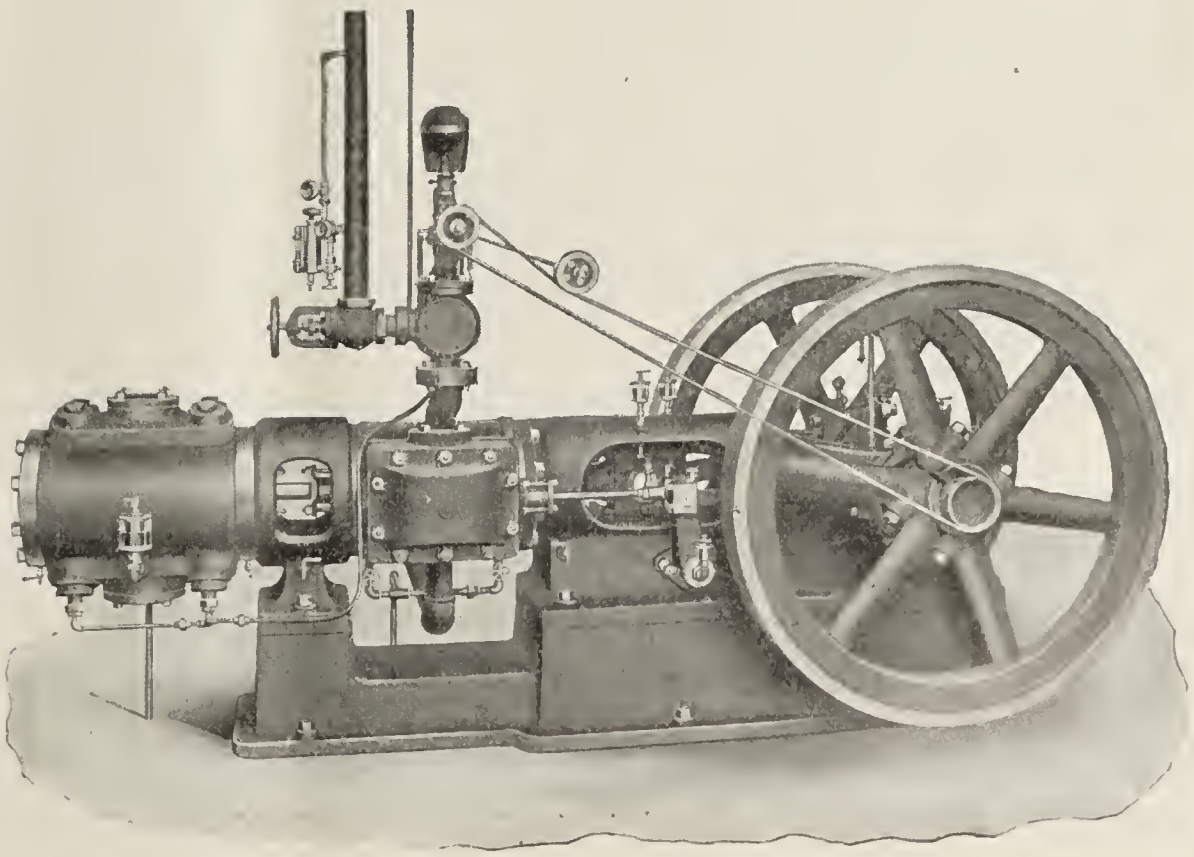
The Thos. H. Dallett Co., of Philadelphia, Pa., has just completed the development of a line of belt and steam driven air compressors, which are fairly well represented by the accompanying sectional elevation of a single steam machine.

A plain D balanced slide valve is used on small and medium size machines, and the Meyer balanced adjustable cut-off valve on larger machines. The rocker arms on all valve gears are provided with means for adjustment, doing away with all wobbly movements and unnecessary lost motion. On steam-driven machines the governor is equipped with a safety stop device, which immediately stops the machine in case the governor belt should break. The governor pulley is situated on the end of the shaft outside of the flywheel on the single steam machine, thus bringing the flywheel as close to the bearing as possible, and reducing the possibility of oil from the eccentric reaching the governor belt.

In some duplex compressors with compound steam cylinders, if the machine stops with the high-pressure side on the dead center, it will not start automatically, this being due to the fact that only the high pressure side takes steam. This trouble has been overcome in these machines by using a reducing valve, which reduces the steam pressure for the low-pressure cylinder. If the high-pressure side stops on the dead center, live steam is fed to the low pressure cylinder through the reducing valve, starting the compressor.

The air and steam cylinders are tied together and held in position by means of an internally flanged tie or distance piece. On the smaller sizes the piece supports the air cyclinder, but on the larger sizes the air cylinder is supported on a pedestal, while the tie piece is of circular design without the foot piece.

Mechanically operated inlet valves are supplied on any size compressor if desired. These valves are ground to gauge and the valve holes lapped to size. Any of the standard low-pressure compressors are stated to be suitable for vacuum service, and are furnished with mechanically-operated inlet valves for a high vacuum.



We are in receipt of a handsome leather bound catalogue, 6½x4 inches, containing useful information in connection with the use of silica, magnesia, chrome and fire clay brick and various refractories as furnished by the Harbison-Walker Refractories Company, Pittsburg, Pa. This company has recently erected at East Chicago, Ind., a modern plant equipped for making the highest grade silica brick.

A bill has bee nintroduced in the Minnesota State Senate providing for the construction of a concrete and steel grand stand for the state fair grounds.

The Lehigh Portland Cement Co., has closed options on 720 acres of land located north of Mason City, Iowa. the purchase price, being $60,000.

We Can Build Fireproof Floors Cheaper *than any one else* in America

All the advantages obtained by the use of monolithic reinforced concrete floors, such as **Absolute Fireproofness, Permanancy, Strength and Better Sanitary Conditions are Retained,** and many other advantages added when concrete floors are built complete in individual units, like the

VAUGHAN SYSTEM OF REINFORCED CONCRETE FLOOR JOISTS

Designs and Estimates furnished upon request.

Manufacturing Contractors wanted.

Write for our Bulletin.

THE VAUGHAN SYSTEM eliminates all centering and false work.

Requires only a minimum amount of material.

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Guarantees accurate results.

TO THE CONTRACTOR: The VAUGHAN SYSTEM means small cost of construction, consequently lower bids—MORE BUSINESS!

TO THE OWNER: Better buildings for less money. The elimination of insurance and repairs,

TO THE ARCHITECT: A structural section of concrete of known strength and materials that can be tested and inspected BEFORE going into the building.

TO THE VAUGHAN COMPANY: A small amount of royalty per square foot as compensation for designing, superintendance and the right to operate under our patents.

Let us give YOU an estimate on YOUR building and PROVE it.

THE VAUGHAN COMPANY

300 Union Trust Building Detroit, Michigan.

CEMENT
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ENGINEERING NEWS

The Vaughan System of Reinforced Concrete Construction.

ruction of floor. Beams are cast at factory and easily placed in floors on delivery to site. Can be done in cold weather and without expensive centering.

CEMENT AND ENGINEERING NEWS

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JOHN F. WALDRON, Advertising Manager

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CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all its branches Engineering notes, public improvements, and facts and opinions drawn from practical experiments will be welcome.

IMPORT DUTY ON CEMENT.

Certain eastern daily newspapers are asking for a reduction of the import duty on Portland cement, which under the Payne bill now pending, leaves the duty at 8 cents per 100 pounds, or about 32 cents per barrel. By the rotary kiln process, we can produce cement about as cheap as in Europe. If the simple cost of manufacture was the only question in issue, cement might be placed on the free list without seriously endangering our own market. The fact is, the foreign manufacturer can, and does obtain a lower freight from our own tide water ports to Missouri River points, than can be obtained for cement originating in the Lehigh Valley, because our own mills are subject to the regulations of the interstate commerce act in the matter of freight charges, while the European manufacturers obtain a through rate from European ports to destination for Missouri River points via steamer and rail, at less than our own manufacturer can obtain with no relief from the interstate commerce commission, whose authority does not extend or cover freight originating outside of this country on through bills of lading to points in the interior of our own country. We recall the fact that cheap and inferior grades of Belgian cements were laid down in Iowa and Nebraska, from Europe via Texas ports over Texas railways at a lower rate than could be obtained from Iola, Kans., to the same points, though Iola was over 700 miles nearer to Nebraska and Iowa than the American port of entry from which these foreign cements were shipped for distribution in Iowa and Nebraska. Had there been no duty on these foreign cements they could have been shipped one thousand miles farther for the price of the tariff duty, and thus monopolize our own markets against the American cement manufacturers.

SIMPLE CONCRETE CULVERT CONSTRUCTION.

Geo. L. Klosterman one of the road commissioners of Palmyra Township, Lee County, Ills., has devised a new method of constructing concrete road culverts, using empty salt barrels for forms. In building a Culvert across a road the first causes a ditch to be dug one foot wider and 18 inches deeper than the diameter of the salt barrel, at either end of the trench an excavation is made about a foot wide and a foot deeper than the Culvert trench and overlapping the Culvert bore about 10 inches on either side, the concrete is next filled into the excavations at the end and a bed of concrete 6 in. thick is placed in the trench and smoothed off to form the bed of the Culvert. With a grade of about 1 in. to 5 feet from the intake to the outlet on this bed of concrete empty salt barrels are placed end to end, allowing the heads of the barrels to remain in the barrels, the open end of the barrels are supported by a piece of board to prevent crushing under the load of concrete which is deposited over the barrels and well tamped at the sides, leaving about 6 inches over the top of the barrels, after the concrete has hardened the top of the Culvert should be at least 6 inches below the grade of the road. This is next filled in with earth to grade of the road. The concrete should be mixed one to seven. That is one of cement to seven of sand and gravel, thoroughly mixed dry to a uniform color and then sufficient water to make a rather wet mix. The heads in the barrels and the board prop can be removed with a long pole. The Culvert should always be sunk low enough to drain all the standing water in the gutter or ditch. The staves in the barrels need not be removed as they will drop out in time.

A CONCRETE PIER AT REDONDO CAL.

The Mercereau Bridge Co., L Angeles, have the contract for t construction of a reinforced concre pier at Redondo for the Pacific Lig & Power Co. It will extend out in the ocean about 600 feet, and will used for the purpose of carrying t large steel condenser pipes from t power station. These pipes consi of three tubes, each 50 in. in diam ter, which convey the salt water ta en and discharged by the condenser

The pier will be of the most sub stantial type. The piles will consi of steel cylinders 18 in. in diamete which are jetted down 18 ft. belo the bed of the ocean. They are the pumped out and a series of steel r inforcing rods are set in a circle, ex tending from the bottom to the to of each pile. The exposed ends c the rods are threaded in order to se cure the steel I beams used to con nect the piles at each bent. Ther are four piles in each bent, the tw inside ones being set perpendicular the outside ones being on an angl so as to form a brace. The stee cylinders, after the rods are in posi tion are filled solid with concrete Timbers bolted at each bent will ex tend along each side of the pier an assist in preserving the rigidity o the structure.

Judge N. A. Patterson who lives five miles north of Johnson City Washington Co., Tennessee is pro moting a company to manufactur cement on the line of the Carolina Churchfield & Ohio Ry., at a poin known as Black Oak, or Indian Ridge through which the above railway has driven a tunnel. An option has been taken on 50 acres of this land at $15,000 at this point.

The U. S. Navy dept. will erect a hollow concrete wireless station at Washington, 50 ft. in diameter, at the base, by 8 feet at the top, with a stairway from the ground to the top. The collecting system will consist of a net work of wire extending from the top of the tower to the ground winding the tower which at its base will be 200 feet in diameter.

F. A. Blackwell, a millionaire railway contractor announced at Spokane, Wash., that $1,000,000 of the capital stock of the Empire Portland Cement Co., has been subscribed. The company propose to erect a plant at the mouth of Sullivan Creek and the Pend Orelle river on the State line between Idaho and Washington, near Newport, Washington.

The Brockett Cement Works and the Fort Scott Hydraulic Cement Works, both at Fort Scott, Kansas are now under one management, Mr. D. P. Thomas, General Manager of The Fort Scott Hydraulic Cement Co., will run both plants, Mr. Charles Gardner, for nine years, manager of the Brockett Cement Works retires from the active management will go to the home office of the Brockett Co., at Kansas City, Mo.

The Peerless Portland Cement Co., was to resume on April 5th with a full force of workmen.

The Enamel Concrete company of Des Moines, Iowa, has shipped its first machine to Seattle, Wash., the purchase price is said to be $50,000.

The Victor Portland Cement Co., which is to erect a plant 14 miles from Victorville, San Bernardino County, California, capital $1,000,000, of which $500,000 is to be used in constructing a railroad from Victorville to the site of the proposed plant. The company has been reorganized, the new officers are:

President, D. A. Mulvaine; first vice president, Lycurgus Lindsay; second vice president, F. E. Engstrum; third vice president, Richard Lacey; secretary, J. G. Meachem; treasurer, Orra Monnette.

Fifteen directors were elected as follows:

Reese Llewellyn, F. E. Engstrum, F. H. B. Banks, L. L. Elliott, Edward Groenendyke, Orra Monnette, Richard Lacey, J. G. Meachem, C. C. Kohlmeier, J. J. Abramson, D. A. Mulvaine, Lycurgus Lindsay, Aman Moore, Harrison Albright, A. A. Baird.

THE CHICAGO CEMENT SHOW.

The Cement Products Exhibition Company, Third Annual Cement Show will be held in the Coliseum on February 17 to 23, 1910, for which elaborate arrangements are already under way, to make the next cement show surpass all previous expositions, neither money or effort will be spared to attain this end.

E. Probst, C. Eng., of Berlin, Germany, has received from the Imperial Testing Laboratory at Charlottenberg, Germany, the degree of Dr. Engineer, being the highest title that can be conferred upon an engineer in the German empire.

A BACKWARD STEP.

Faulty Engineering specifications for combined curb and gutter construction at Covington, Ky., in combination with cement sidewalks which were laid flush and in contact with the curb and gutter. During the hot summer weather the cement sidewalks would expand and exert a thrust against the curb, causing cracks, after throwing the curb out of perpendicular. Now City Engineer Meiners, proposes to abandon the use of concrete curbing and substitute oolitic lime-stone curbing. Just how the lime stone curbing is going to mend matters is not clear, if the lime stone curbing is laid flush, and in contact with the cement walks, it will overcome the defect charged to the concrete. The sidewalk should either be laid over the curb or far enough away to leave an inch or more of earth for an expansion joint. Years ago when cement walks were laid in continuous blocks and confined by the curbing at each end, the cement walks would expand sufficiently to tear out the curb at each end of the block. This was remedied by simply cutting down the curb and extending the sidewalk slab so as to rest on the curb. The sidewalk could then freely expand and contract without injury to the curb. The same thing can be done by the City Engineer of Covington, if he can grasp the idea, as it is the substitution of lime stone curbing for concrete curbing is simply a step backward.

The Sandusky Portland Cement Co., of Sandusky, O., are supplying their White Portland Cement for use on the following important contracts:

Point Bldg., Cleveland, O.

Western Newspaper Union Bldg., Chicago.

Clean Dairy Co. Bldg., St. Louis, Mo., for cement floor work.

Campbell Bldg., Oklahoma City, for facing the entire front.

Battle Creek Sanitarium, for finishing bath rooms.

Dormitory, Pomona College, Claremont, Cal., entire exterior finish.

Northwestern University Bldg., Evanston, interior stairs and baluster work.

They are also furnishing their Medusa Waterproof Compound on important contracts, the following representing a few of them:

Swimming Pool at Wilmerding, Pa.

Blackstone Hotel, Chicago.

City Hospital, St. Louis, in plaster and wainscoting.

U. S. Government work, Portland, Me.

St. Anthony Hotel, San Antonio, Texas.

D. L. & W. Collieries, concrete dam, Scranton, Pa.

E. Jersey Water Co., concrete sewage tank, Summit, N. J.

GREAT WESTERN PORTLAND CEMENT CO.

During March the Great Western Portland Cement Co. began production at its Mildred (Kans.) plant, which has a daily capacity of 2,000 barrels of Portland cement, this being the first unit. The company has constructed a modern plant for the manufacture of high-grade cement in the most economical manner, and has already sold more than 500,000 barrels of its product. This quantity is being shipped at the rate of twenty carloads a day, and the company has already arranged to increase its capacity to 4,000 barrels daily by June 1. The Great Western Portland Cement Company is capitalized at $3,000,000, and its officers include: President, John W. Wagner, president of the German-American Bank; secretary-treasurer and general manager, Charles H. Apple; sales manager, H. G. Calkins, all of Kansas City. The company's general offices are located at 712-720 American Bank Building, Kansas City, Mo.

KOSMOS COMPANY NOW SHIPPING CEMENT.

The Kosmos Portland Cement Company states that it is now shipping Portland cement from its reconstructed plant at Kosmosdale, Ky. It began rebuilding last October, and has replaced the old buildings with fireproof structures erected of steel and concrete. All the damaged machinery has been replaced and the entire equipment is in the best of condition for the production of high-grade cement at a minimum cost. The company contemplates doubling its capacity later in the year. Its sales offices are located in the Paul Jones Building, Louisville, Ky.

A CORRECTION.

In your issue for March just received, you have an article on the Huron Portland Cement Company Plant at Alpena, Mich. In this article you say that the cement is ground in fourteen Kent Mills. This is an error as the installation of Kent Mills has been removed and the Company referred to is installing twelve Bonnot Pulverizers manufactured by the Bonnot Company of Canton, Ohio, for grinding their cement. The other installation did not work to their satisfaction, and last fall they tried out one of Bonnot's pulverizers and on the strength of the results obtained placed an order for twelve, and proceeded to remove the other installation.

I thought possibly you might be interested in having this information.

Yours truly,

A. A.

A NEW METHOD OF USING FORMS FOR BUILDING A CONCRETE HOUSE AND SOME COSTS.

The cost of building houses of concrete is high, owing to the fact that the form work is quite expensive. Cost data on house building are meagre, but from records given in this journal and Gillette & Hill, "Concrete Construction, Methods and Cost," the cost of form work alone amounts to $3.50 or more per cu. yd. In most cases the cost of forms being nearly $5.00 per cu. yd. This means that on an average 45 per cent of the total cost of concrete in a house, is for form work.

The reasons for this are evident. A large amount of lumber has to be bought to make the forms and to be used as props to hold them. This lumber is seldom used more than three times on a building and often is used but twice. Carpenters have to frame and erect it, and frequently have to assist in taking down the forms. These things are bound to make the cost run high.

To overcome the excessive cost of forms a system known as the "Two-Board Form Method" has been devised. The Dietrich Clamp Co., have originated this system and it is stated that it can only be used in connection with their clamps, the reason being that with these clamps the form boards can be removed while the concrete is still damp without interfering with the settling of the wet concrete. This method seems bound to play a very important part in reducing the cost of concrete work, and for that reason we give space to a detailed description of it.

The accompanying cut showing a dwelling house that has been built with the Two-Board Form Method and the Dietrichs clamps in New Jersey. For this work the wall form clamp and the corner clamp are used. The wall form clamp has a hook head on it that hooks onto a loop of wire. The body of the clamp goes through the form boards and is held in place by means of the key. The wires are cut to the length needed and bent in advance.

The form boards are made of 7/8-in. plank, planed on two sides. These are strengthened with battens of 1¼x 3-in. strips, placed 30 ins. apart. Two 7/8-in. auger holes are bored through the battens and planks to take the clamps. After the forms are made, either enough to go around the building, or around some section of it, if the structure covers a large area, they are given two coats of good metallic paint on both sides. As they are being used each time, the inside of the form is painted with a mixture of lard and kerosene, which prevents the cement from adhering to the forms.

After the foundations and footings are in place, the form boards are set up, the two sides being connected by the wires and clamps. Before lining up the forms some concrete is thrown into them at intervals, which gives some rigidity to the forms and keeps them in place when lined up. The forms are lined by a mason's line and plumb and level, in a manner similar to bricklayers starting off a wall and carrying it to any desired height. As soon as the forms are in place and lined up, concrete is put in them all around the building. In the building illustrated, a Hain's Telescopic Mixer was used with a derrick to operate it. It will be noticed that three men with a hoisting engine are doing all the work on this building.

The forms are in such units that they are easily handled and need no braces or props to hold them. After they are made a carpenter is not needed. Only a few men are worked on the building, as the mixer is loaded from stock piles, and serving into space, mixing the concrete as it goes through the air, and spilling it directly into the forms. This mixer and the system of forms thus does away with all unnecessary attendance, as men placing extensive forms, props and braces, men wheeling concrete barrows and placing concrete and a large number of men feeding the mixer are not needed. The water for the concrete is thrown into the top hopper, shown in the illustration, before the derrick hoists the mixes. It is claimed that with the Hains Telescopic Mixer and the Dietrich system of forms only, it is possible to thus cut down the labor needed in building a concrete house.

As soon as the concrete is brought to the top of the two boards, the lower form board is taken down and placed on top of the second board. This operation is being performed by the men in the photograph. It is possible to do this while the concrete is still damp, as the clamps and boards come off as easily as a door is opened, so that there is no jar, as with bolts, pipes, twisted wire and other form holders and separators to interfere with the set of the concrete. After the lower forms are raised to the top they are lined up as already explained. The operation of filling and raising the forms is continued until the building is completed.

It will be noticed that the window and door frames are all placed, as the house is built exactly as is done in building a brick house. Indeed, with the two-board form method all the work is done in a manner similar to brick work. If concrete floors are to be used the forms for the floors are placed as the walls are being built and when they reach the floor it is put in place, being monolithic with the walls. Then the second story walls are carried up. With this method a real monolithic structure is obtained as the concrete is placed continuously and not once a week as is done when high and extensive form work is used.

Dwelling house built of Two-Board Fo rm Methods and the Dietrichs clamps.

To build the corners, the Dietrichs corner clamp is used on the outside of the form, while on the inside a small angle iron is used, to prevent the two boards meeting at the corner from binding when they are taken down. The operation is very simple.

The walls shown in the illustration are 8 ins. thick. The cost for all labor, including the labor of placing the forms as above described, of charging the mixer, of mixing and placing the concrete, in fact the entire cost of the concrete except for the materials, as stone, sand and cement was 6 cts. per sq. ft. of wall, or $2.40 per cu. yd. of concrete, wages for the men being $1.50 for a 10-hr. day. This cost, as everyone familiar with buildings will know, is exceedingly low.

On a stable built in Philadelphia with the two-board form method and

the Dietrichs clamps, a great saving was effected on the forms. The lumber used on the forms and scaffolding was afterwards used in the roof of the building. The contractor, Mr. C. R. Knapp, stated that he saved 10 per cent of the ordinary cost of forms used for this class of work, and built a building of concrete for less than a brick structure or frame stable could have been erected.

The Dietrichs clamps are made by the Dietrichs Clamp Co., of Little Ferry, N. J.

CONCRETE FREEZING TANKS.

An experience in the construction of reinforced concrete freezing tanks was referred to in a paper before the recent meeting of the American Society of Refrigerating Engineers by Mr. Wm. M. Torrance, New York. The tanks are 27½ ft. wide by 39½ ft. long and 4 ft. deep, inside, and have a floor and walls 8 in. thick. The latter are reinforced with cold twisted steel bars, ⅝ in. square, placed 12 in. center to center in each direction, so that the entire area of base and sides was gridironed with these bars. By calculation for range of temperature from —10° F. to —90° F., these rods were found sufficient to take care of temperature strains. The vertical rods in the side were made continuous with those crossing each other in the base, the bend at the corner being made cold so as to preserve for the steel the extra strength due to twisting the rod in the first place. This bend is near the inner surface of the concrete, while the general location of rod is near the center of the slab. This is brought near the inner surface to take care of the stresses induced at the corner by the hydraulic pressure of the brine against the sides of the tank.

In these tanks the insulation consisted of screened cinders filled with coal-tar pitch, a kind of insulation that is not recommended by some, but, nevertheless, it has much to recommend it. Cinders cost nothing but transportation, as a rule, and coal-tar pitch, besides being comparatively inexpensive, is impervious to moisture, as well as a fairly good insulator. There can be little question, but that, being a mineral substance, its life as an insulator will exceed that of a purely vegetable substance, as cork. Being incapable of absorbing moisture, it will always remain insulating. If the cinders are well screened of all dust and the spaces between the individual pieces of cinders deposited loosely, are well filled with the boiling hot pitch, one could not ask for a better result than will be obtained, provided, of course, that sufficient thickness of the insulation be used. Of course, another great advantage of this type of insulation, whether used outside a steel tank or outside a concrete tank, is its additional property of non-absorption of moisture, being, if well placed, a waterproofing. Thus, if the brine or any portion of it could find an opening through the steel or concrete it could not leak away through or into the insulation, thus being wasted and spoiling the insulation at the same time, if this form of insulation were in use.

This insulation was for the floor, placed on the top of the foundation, before the tank was built. That on the sides was placed afterward, the outside concrete forms being moved back and the cinders and tar being placed in the space between them and the finished concrete wall. It was decided that the concrete itself has about the same insulation coefficient as a brick wall or about half that of the cinders and tar, so that for the same degree of perfection in insulation several inches of the thickness of this cinders and tar mixture were saved.

Oftentimes steel tanks are worn out after only a few seasons of use. This is often due, as is well known, to the habit of the operatives of strengthening their brine by adding common salt (NaCl) instead of the calcium chloride ($CaCl_2$), which they should have on hand, but which is either lacking or, from the operatives' standpoint too expensive. This common salt, of course, rusts the tank out very rapidly. While to many this might not be considered a recommendation for concrete, this practice, Mr. Torrance states, would not injure a concrete tank, as neither NaCl brine, nor $CaCl_2$ brine would have any chemical effect on well-made concrete. In fact, with a concrete tank installation it might be found to be cheaper to use NaCl altogether and not get the more expensive $CaCl_2$.

The Empire Construction Co., 25 West 42nd street, New York, has been organized to engage in the concrete and cement paving business. Mr. A. Patrizio is president and Mr. H. T. Henderson is secretary and treasurer. Both were formerly connected with the Neuchatel Asphalte Co.

The Mallory Steamship Co., and the Morgan Line of Steamers have increased the freight rates on cement from New York to Gulf Ports from 5 cents to 11½ cents per hundred while great reductions have been made on about all other commodities.

The natural cement plant at Hausdale, Clark Co., Indiana, is to be converted into a Portland cement plant.

CONCRETE TELEGRAPH POLES.

In continuance of the declared policy of the Pennsylvania Railroad system to provide against timber scarcity, the lines west of Pittsburg have just completed and placed in experimental service a line of concrete telegraph poles through New Brighton, Pa. Its construction followed a series of elaborate experiments which have been conducted during the past two years.

Owing to the fact that wooden poles are constantly becoming more expensive and more difficult to obtain, the Pennsylvania in 1906 began to test the value of concrete as a substitute for wood. Fifty-three reinforced concrete poles were set up in the line along the Pittsburg, Fort Wayne & Chicago Ry. near Maples, Ind. A year later they were giving entire satisfaction and showed no evidences of decay.

According to the experiments made so far, it is thought that a concrete telegraph pole will last for many generations, thereby doing away with the frequent changes necessary with wooden poles. Much importance is also attached to the increased strength of the new poles, which hold the strain of the line, even on curves, without any braces.

The poles at New Brighton are of graceful proportions, being about 30 ft. long, 14 in. in diameter at the bottom and 6 in. at the top. Their general appearance is particularly pleasing on account of the uniformity in size, shape and color.

Between 1,500,000 and 2,000,000 cu. yds. of rock will be used for the concrete work in the locks and dams at Miraflores and the locks at Pedro Miguel on the Isthmian Canal. The rock will be quarried from the south slope of Ancon Hill, and will be transported from the quarry by train to the crushers. The crusher plant will consist of one large and four auxiliary crushers. The large crusher will take pieces of rock as large as 36 by 36 ins. as they come from the quarry and reduce them to 5 ins. or less. This crusher can handle 400 cu. yds. of rock an hour. Such rock as comes from the quarry in pieces that will pass through a 5 in. ring, and the product of the big crusher, will be conveyed by gravity to the four auxiliary crushers, where it will be broken into pieces that will pass through a 2½ in. ring. From the auxiliary crushers the rock will be conveyed to cars on a siding now in process of construction whence it will be hauled to the works at Miraflores and Pedro Miguel. Power for running the crushers will be supplied from the electric power house at Miraflores.

NEW COWELL CEMENT PLANT IN CALIFORNIA.

The new plant of the Cowell Portland Cement Company, in Contra Costa county, California, is reported to be one of the big concerns of its kind in the West. It was erected according to plans and specifications of the Osborn Engineering Company, of Cleveland, O. The officers of the company are: E. V. Cowell, president; S. H. Cowell, vice-president; I. M. Cowell, treasurer; W. H. George, secretary. The Henry Cowell Lime and Cement Company, of 95 Market street, San Francisco, will handle the product of this plant. Operations have commenced, as have also those of the Great Western Power Company, which supplies the power. The new concern is capitalized at $1,500,000. A description of the plant should be interesting to our readers and will show that it is up to date and finely equipped in every particular.

The operations are located on one of the foothills at the north slope of Mount Diablo, about four miles from Concord. The plant is connected by its own standard gauge road, eight miles long, with the Southern Pacific and Santa Fe railroads at Bay Point, and is equipped with two heavy locomotives and other rolling stock. This location, relative to its raw material, is most ideal. The limestone is of tracertine formation and is situated on a ridge back of the mill and elevated above the mill about 100 feet, and the clay is present in the same formation with the limestone, so that both materials can be worked from the same level. The rock and clay are excavated by two No. 91 Marion steam shovels and loaded into V-shaped top dump cars, furnished by the Kilbourne & Jacobs Mfg. Co. of Columbus, Ohio, which have a capacity of seven yards each. These are then hauled to the crushing plant by two dinky locomotives furnished by the Vulcan Iron Works.

The crushing plant consists of one No. 9 and two No. 6 Allis-Chalmers crushers and so situated that the cars can be dumped into any one of the crushers, and all material is screened to 1½-inch ring. It is then carried by a 30-inch belt conveyor to the stone and clay bins, situated over the standard gauge track and on the same level as the works. One part of the bins is used to store the crushed rock and the other the clay. Standard gauge cars draw the materials from the bottom of these bins and deliver it to the plant one-half mile away. The cars run into the plant over the concrete storage bins so that the loads are dropped into the bins below. The bins have a capacity of three weeks' supply both of rock and clay. The rock is drawn from these storage bins from tunnels below the bins and equipped with 20-inch belt conveyors. The material then passes to three 5 by 60-inch rotary dryers furnished by Vulcan Iron Works, Wilkes-Barre, Pa., with oil firing; then it falls into a a link belt bucket conveyor and passes to the raw grinding building and to the bins over eight Krupp mills.

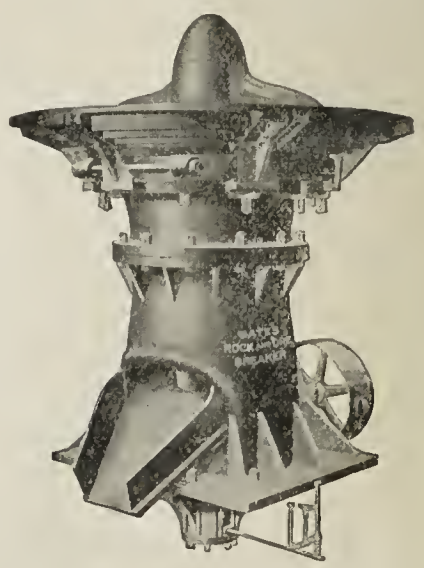
Cowell Portland Cement Plant.

The clay is delivered to the plant in the same way as the stone, but first passes into a preliminary storage bin of three hundred tons capacity, and from there is fed into the 9-inch dry pans, and then to two concrete 5 by 60-inch rotary dryers and then passes into the main concrete storage bins of same construction and arrangement as the stone bins. Caldwell screw conveyors are used to carry the material from these bins, and from them it passes to a final clay dryer, and thence to two Williams mills; from there to ground clay storage bins. The limestone is stored after the ball mills. The clay and limestone are weighed and mixed at this point by means of a tandem set of Richardson's automatic scales, which drops its load into two hoppers below the machines, and the gates in these bins are so adjusted that the charges are voided in the same relative time, but a little faster than the weighing machines are operating.

The charges are voided onto a double screw conveyor—right or left hand—which mixes the materials and carries to the elevator which feeds the bins over the ten tube mills, which were furnished by Allis-Chalmers Co., of West Allis, Wis. Each tube mill and ball mill has feed bins which hold twenty-four hours' supply of material. This is also true of the bins which feed the kilns. There are eight kilns 7 feet 6 inches in diameter by 110 feet long, oil-fired and using a high and low pressure air supply for the burners. The kilns were furnished by Vulcan Iron Works, Wilkes-Barre, Pa.

The clinker from the kilns is delivered into pits and so arranged that each pair of kilns delivers into one pit. It is then picked up by a bucket elevator and dropped into four rotary coolers 5 by 70 feet standing immediately behind the kilns. The clinker is sprayed in the elevators and also the coolers, and after passing through the coolers is then delivered onto a belt conveyor in a tunnel under the floor and passes to an automatic weighing machine, and at this point it can either be passed to a belt conveyor which would carry it to the clinker grinding building or deflected to an elevator and then to a belt distributing system over the clinker storage floor. Here there is facility for storing 225.000 barrels of clinker. The clinker storage floor is equipped with tunnels and belt conveyors so that clinker from any part of the floor can be moved and these cross belts void onto the main belt, which connects with the clinker grinding building. This building is equipped with ten ball mills and fourteen tube mills, each with feed bin storage capacity of twenty-four hours.

The cement warehouse has thirty-two bins of reinforced concrete, each bin holding 4,000 barrels. The cement is drawn from the bins by means of screw conveyors in tunnels under the bins, and the packing floor is equipped with eight Richardson automatic weighing and packing ma-



Crushers installed by Allis-Chalmers Co.

chines. From there it can be either loaded directly into cars or tripped back upon a belt conveyor, which delivers it into the sacked cement storage building, which has a capacity of 40,000 barrels.

The machine shop is large and roomy and thoroughly equipped with the most modern high-speed tools. A large and ample storehouse stands next to the machine shop and both are furnished with overhead traveling crane for handling heavy supplies and parts.

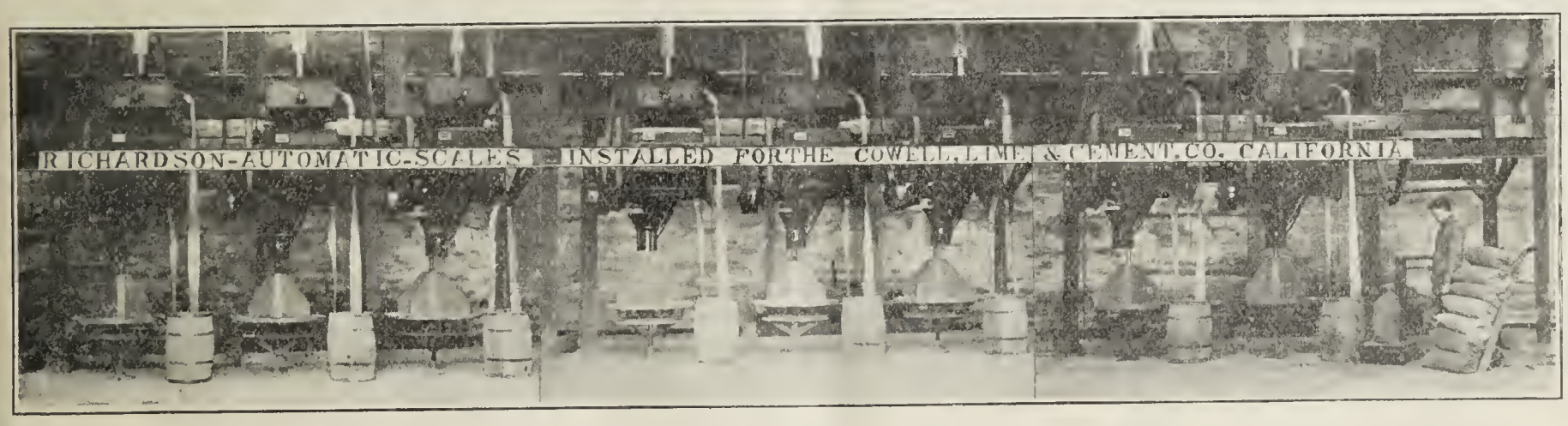
The compressor building is equipped with two 110-horsepower Erie boilers; two Class 2 belt-driven air compressors, which supply compressed air to the quarry, and for the oil burners; and two No. 12 high-pressure Sturtevant rotary blowers for the low-pressure air service for the oil burners. The main switchboard room is of solid reinforced concrete.

The buildings are all of steel sheathed with galvanized corrugated iron. The power necessary to run the plant is furnished by the Great Western Power Company, generated 158 miles up the mountains; it is three-phase, 60-cycle and 100,000 volts and brought down to the plant on a double system of wires supported by galvanized steel towers. At the plant they transform it from 100.000 volts down to 480 volts in one step. The plant is equipped with motor drives of the Bullock high-tongue type, furnished by Allis-Chalmers Co., Milwaukee, Wis., three-phase, 60-cycle, 440 volts, each machine having its individual motor, insuring only the minimum loss by any one breakdown; no expense has been spared to make the mill as complete and economical as possible. All the belting used in this plant—for direct drive from each of the four grand divisions to the next as well as all other connections—was furnished by the Chicago Belting Company, of Chicago. The buildings have been laid out with ample room and with archways around them for easy access and plenty of good air.

One noteworthy feature about this plant is the fact that it is laid out in a straight line in natural sequence of operation—that is, departments which follow each other in the successive stages of manufacture from raw material to finished product also adjoin in the plant. Thus unnecessary equipment and manipulation are reduced to the minimum.

The company own about 1,700 acres of land and the supply of raw materials is inexhaustible. It has a great advantage in owning its own water supply, fully ample, and originating on the property. The whole plant bears evidence of solidity and success and there is not a cheap or inferior feature about it.

The company has built twenty-five fine cottages for its married employees, each cottage being furnished with a bathroom and electric lights; and is now building two brick stores and have the plans out for a fifty-room hotel. The office building is commodious and the chemical laboratory and physical testing room are as finely equipped as any in the country.



The Farwell Portland Cement Co., which has a partially completed plant near Farwell, Clare Co., Mich., upon which $100,000 has been expended, now desires to change from a mail proposition to rock, and has made a proposition to Petosky citizens to take an equal amount ($100,000) in stock and bonds as an inducement to have the cement company locate at Petosky, where there is an abundance of suitable lime stone.

The addition to the new plant of the Crescent Portland Cement Co., at Wampun, Pa., is to be completed by May 1st.

The buildings are of reinforced concrete with steel truss and cement tile roof. They are fireproof and modern in design. The grinding plant is 120x60 feet, kiln building 200x120, dry grinding building 480x60, stock house 400x80, power house 80x60, boiler house 60 x 40, machine shop 80x40, and a stack 175 feet by nine feet inside diameter. The new addition will add 3,500 barrels per day to the capacity of the plant.

ATLANTIC & GULF PORTLAND CEMENT CO.

The Atlantic & Gulf Portland Cement Co. is proceeding with the construction of its plant at Ragland, Ala., the foundations for the buildings being about completed. This company was organized some time ago wtih a capital stock of $1,000,000, and is authorized to issue bonds for $1,500,000. Its plans involve the erection of modern buildings and the installation of machinery for manufacturing Portland cement, the first unit to have a daily capacity of 1,000 barrels of cement, which will be increased to 3,000 barrels, and production is expected to begin next September. The company owns 6,140 acres of land at Ragland, St. Clair county, and Tredegar, Calhoun county, Alabama, containing extensive deposits of coal, limestone and shale, estimates of these deposits placing the coal at 30,000,000 tons and the limestone and shale at 200,000,000 each. The property is located about halfway between Birmingham and Atlanta, on the Atlanta & Birmingham division of the Seaboard Air Line, making the location a most suitable one for the establishment of a Portland cement plant. Plans, specifications and estimates of cost have been prepared by the Wm. B. Shaffer Engineering Co. of Nazareth, Pa., of which J. S. Herbert is chief engineer, and have been approved by the Henry S. Spackman Engineering Co. of Philadelphia. The Atlantic & Gulf Portland Cement Co. has its executive offices at Nazareth, Pa., and its officers are: President, Wm. B. Shaffer, general manager of Wm. B. Shaffer Engineering Co., Nazareth; vice-presidents, John S. Osterstock, Easton, Pa., and Henry K. Hartzell, Allentown, Pa.; secretary, Wm. S. Wilson; treasurer, Geo. Crane.

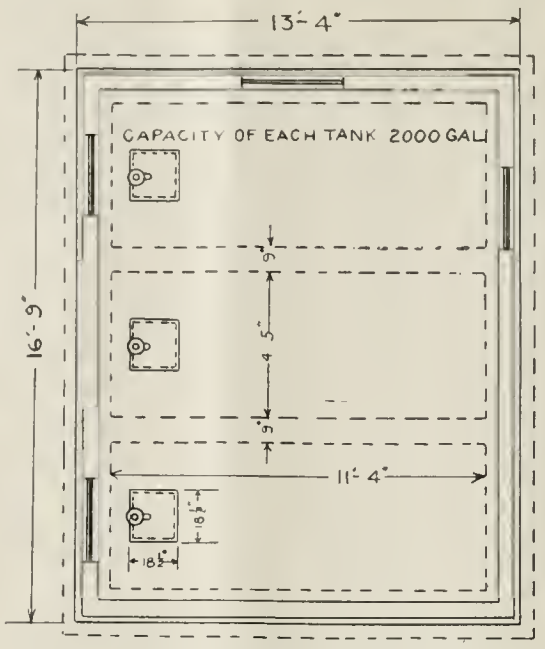
Mr. B. H. Davis, assistant engineer of the Delaware, Lackawanna & Western R. R., in charge of concrete design, is at present making an extended tour of the South studying plain and reinforced concrete railroad structures.

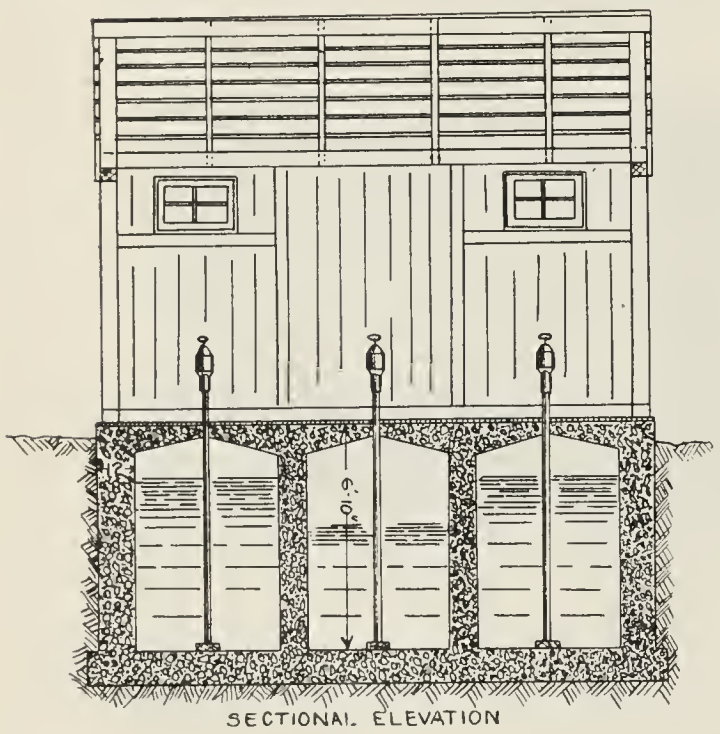
CONCRETE OIL TANKS.

We have received many inquiries relative to the use of concrete in tanks for the storage of oil. Owing to its absolute fire proof qualities, concrete is wonderfully well fitted for the purpose. The accompanying sketch shows how one cement company has constructed a series of three tanks for use in this way.

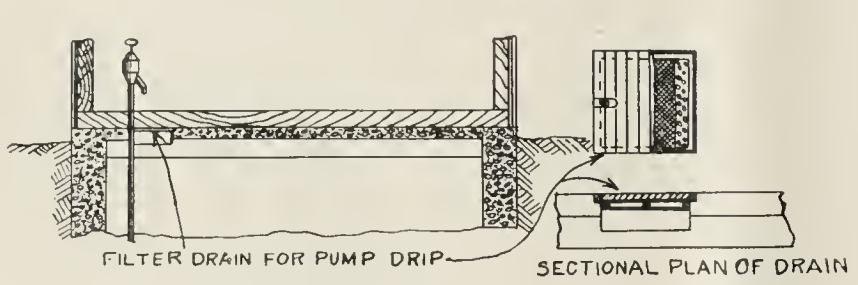
The concrete was made of one part Portland cement, two parts sand and four parts crushed stone passing through a one-inch ring. The interior walls were plastered with a rich Portland cement mortar, smoothed and well trowelled in order to give a dense finish to the plaster lining. The tank has been in use since 1900, and has never leaked, giving perfect satisfaction.

Cylinder, crank case and block oil are stored in the three divisions of the tank.





SECTIONAL ELEVATION



The Phoenix Reinforced Concrete Co., of Phoenix, Ariz., are building the Mesa Valley bank building at Mesa, Ariz. This is a reinforced concrete building throughout. The banking room has a 26-ft. ceiling, and will have vaults and all up-to-date appointments. They are also constructing a one-story business building. 158x137.6 ft. at Mesa, for the Mesa Realty Co. Thornton Fitzhugh, of Los Angeles, prepared the plans for both these buildings.

Much of the good work being done in the Philippines is little known to the people of the United States. The recently completed scheme for supplying Manila with water is a case in point. The supply is taken from a watershed 140 square miles in extent, being drawn from northeast of Manila. The works include a forty-two-inch steel pipe ten and one-half miles in length, a concrete tunnel four and one-half miles in length and a reservoir of 50,000,000 gallons capacity. The capacity of the systen is 22,500,000 gallons per day, equivalent to 100 gallons daily for each person in Manila.

Edmonton, Alta, Canada.—Forty-three new elevators will be built in this province during the current year. The Alberta Pacific Elevator Company will build twenty-five, the Alberta Grain and Elevator Company, eight, and private firms ten. The majority will be in the southern part of the province, although a few are as far north as Strathcone.

The Vindex Portland Cement Co., at Malltown, Pa., is to be controlled by the Allentown Portland Cement Co., which is nearing completion. The combined capital of these two plants is $2,500,000, both are located on Railways controlled by the Pennsylvania Ry., Philadelphia, is expecting a lower cement rate on account of this combine as direct shipments from the mills can be made to Philadelphia.

The New York and New England Cement and Lime Company, with a capital of $3,000,000, was incorporated to-day with the Secretary of State. The directors are: Alfonso de Navarro, John R. Maxwell Jr. and Henry L. Maxwell of New York; Howard W. Maxwell of Brooklyn, Henry Graves, Jr., of Irvington, Willis E. Miner of Roselle, N. J.; Harry J. Seaman of Catasauqua, Pa.; James N. Catlow, West Orange, N. J., and A. C. Crell of Allentown, Pa. This company will build a cement plant at Greenport, near Hudson, N. Y.

C. M. Winslow of Chicago is looking up a location for a Portland Cement Plant in Iowa, through the greater Iowa Club of Des Moines, Iowa, E. B. Hill, Secretary.

AT THE ANNUAL MEETING OF BONNER SPRINGS PORTLAND CEMENT CO.

The Bonner Portland Cement Company held their annual stockholders meeting at Bonner Springs, Kas., April 6. Over 250 of the stockholders were present, and after an examination of the mill a lunch was served at the company's hotel after which the business session convened.

All of the old officers and directors were unanimously elected and two new directors added to the board, Philip Graff, a capitalist of Beatrice, Neb., and L. P. Kindred, a banker from Bonner Springs, Kas., thus giving the board of directors as follows:

W. H. Caffery, Charles Knabb, J. D. Waters, A. L. Cooper, C. C. McCarthy, Charles Steeper, Louis Graff, W. B. Richards, G. G. Green, Philip Graff, L. P. Kindred, making one of the strongest boards of directors in the country.

W. H. Caffery was re-elected president of the company, Charles Knabb, vice president, A. L. Cooper, secretary and J. D. Waters, treasurer and Cooper & Wilson general counsel.

The Lake Shore Portland Cement Co., which is constructing a plant, just west of Sandusky, Ohio, has taken out incorporation papers under the Ohio laws. Capital stock is $1,500,000.

The Utah Keine Cement Co., of Richfield, Sevier Co., Utah, has been organized, capital $160,000, $30,000 preferred and $130,000 common shares.

A charter has been issued to the Prairie Portland Cement Company, of Nowata, Okla. The incorporators are: Thomas J. McCormick and James Brennemann of La Salle, Ill.: Otto Proless, of Kansas City, Mo.; J. E. Curtis and O. Gerlach, of Iola, Kan. The capital stock is $1,700,000.

From a competition in which sixteen bidders took part, each submitting a number of designs, the committee on water of the city council of Richmond, Va., recently on recommendation of a board of engineers forwarded to the Common Council for approval a contract with the Piedmont Construction Company, of Atlanta, Ga., for a 54-inch interior diameter circular reinforced concrete conduit, to rest on the present base. The contract price is $56,000, the new flume having an estimated delivery of water under average conditions of 41,300,000 gallons each twenty-four hours.

CEMENT EXTERIORS.

Concrete plaster for use in the place of siding in the exterior of residences is regarded as an economical method of finishing, and the growth of this material has been encouraged by the scarcity of lumber and the consequent increase in the price of that material.

It is good practice to apply two coats, the first called the scratch coat composed of five parts of Portland cement, twelve parts of clean coarse sand, and a small quantity of hair. Some builders use a small percentage of lime in the mixture. The second or finishing coat consists of one part of Portland cement and two and one-half parts of clean sand.

The Lehigh Portland Cement Co., has been making borings on the land upon which it has options at Mason City, Iowa, to test the value of the work for cement making purposes. The work is being done under engineer Fisk for the Lehigh Company.

The contract for the construction work involved in the Hydro Electric Development of the Grand Falls Power Company on the St. John River at Grand Falls, New Brunswick, has been placed n the hands of the Frank B. Gilbreth organization of New York. Mr. John B. McRae, of Ottawa, Canada, is the chief engineer and Mr. Ralph Mershon of New York, is the electrical engineer. About $5,000,000 will be expended.

The Union Portland Cement Co., of Rushsylvania, Logan Co., Ohio, has resumed. The company is asking for a $25,000 subscription from the people of Logan County to keep the plant in operation until the money can be repaid from the earnings.

The Piedmont Portland Cement Co., whose plant is under construction at Davitte, Georgia, is to be completed about June next, with an output of 500 barrels per day.

The Government engineers, Salt River Project, Roosevelt, Arizona, report 77.5 per cent of the work completed. The contractors have laid 14,500 cubic yards of masonry in Roosevelt Dam during February, bringing the average elevation of the highest part of the dam to 104 feet and that of the lowest part to 80 feet. The cement mill has been running during the month with an output of 12,330 barrels burnt and 12,380 barrels ground. Satisfactory progress was made on the transmission line, Grand Canal, South Canal and the well driving on the Indian reservation and south of Mesa. A concrete caisson is being sunk at one of the wells. The type of well finally adopted will depend upon the result obtained from this well as compared with the drilled wells.

On January 15 proposals were opened at Portland, Oreg., for 25,000 barrels of cement for Pacific Coast Irrigation projects. The names of bidders, prices per barrel, and the points of delivery are as follows:

Contract has been awarded to the Pacific Portland Cement Company, Con.

The cement testing laboratory of the Reclamation Bureau will be moved from Chicago, Ill., to Denver, Colo., about April 1, and the address of the cement expert will thereafter be 408 Commonwealth Building, Denver, Colo.

CEMENT CONSTRUCTION AT WICHITA.

The Wichita, Kansas Sunday Eagle under date of February 21, 1909, devoted 8 pages to concrete construction, describing and illustrating articles on reinforced concrete bridge work. Concrete chimneys, concrete dwellings, business blocks, theatre, building, warehouses, a large church of cement blocks, a club house and concrete railway ties. 33 large sized cuts appear in this issue of work in concrete either under way or finished, all within the city of Wichita, about $500,000 worth of new work has been planned for the season of 1909 to be erected in Wichita.

The American Cement Plaster Co., of Lawrence, Kan., has purchased 100 acres of Gypsum land near Fort Dodge, Iowa, upon which a large fireproof mill will be erected of stone and concrete, the kettle capacity will be 250 tons per day.

King, Rice & Ganey, 280 Broadway, New York, were awarded the contract at $610,452, for contract No. 16. for the Catskill aqueduct, the work including the construction of about 2½ miles of plain concrete aqueduct, known as cut-and-cover aqueduct, 17 ft. high by 17½ ft. wide inside, between New Hurley and a point about 2 miles east of Walkhill, in the town of Shawangunk, Ulster County, New York, approximately 13 miles southwest of Poughkeepsie.

The Dengnon Contracting Co., New York city, has been awarded the contract for constructing the Wallkill siphon for the Board of Water Supply of New York city. The contract price is $4,982,726.

The Alpha Portland Cement Co., is reported to have purchased the Buckhorn Portland Cement Co., at Manheim, W. Va., at about $500,000. Improvements to the extent of $250,000 are to be made at once. The company has been in the hands of a receiver for some time, R. M. Patton being the receiver. G. S. Brown, Sec'y., and Treas. of the Alpha Co., closed the deal with the receiver. John T. McGraw and Abian C. Mott were the principle stockholders of the Buckhorn Co.

Messrs. Frederick G. Myhlertz and Edward T. Walsh have associated and will carry on a consulting practice in the design and superintendence of reinforced concrete structures. Offices have been taken in the Perry Building, Philadelphia.

The Appellate Court of the state of New York has decided that a Municipal Corporation cannot legally levy an assessment against private property without first having ordered such a sidewalk by a resolution of the common council.

The Coal Valley Mining Co., is planning the erection of 25 concrete block houses at Winchell Mercer Co., Ills., a new town located between Premtion, & Gilchrist, Mercer Co., Ills., on the Chicago, Rock Island & Pacific Ry. The Coal Valley Mining Co., has an office at 84 Van Buren St., Chicago.

The Glencoe Lime & Cement Co., of St. Louis, Mo., has given a trust deed to the St. Louis Union Trust Co., as Trustee for bond holders for a 20 year bond issue. The Glencoe Co. has absorbed the Chas. G. Goetz Lime and Cement Co., and other concerns and has increased its capital stock from $50,000 to $1,100,000.

HOLLOW WALL CONCRETE SILOS.

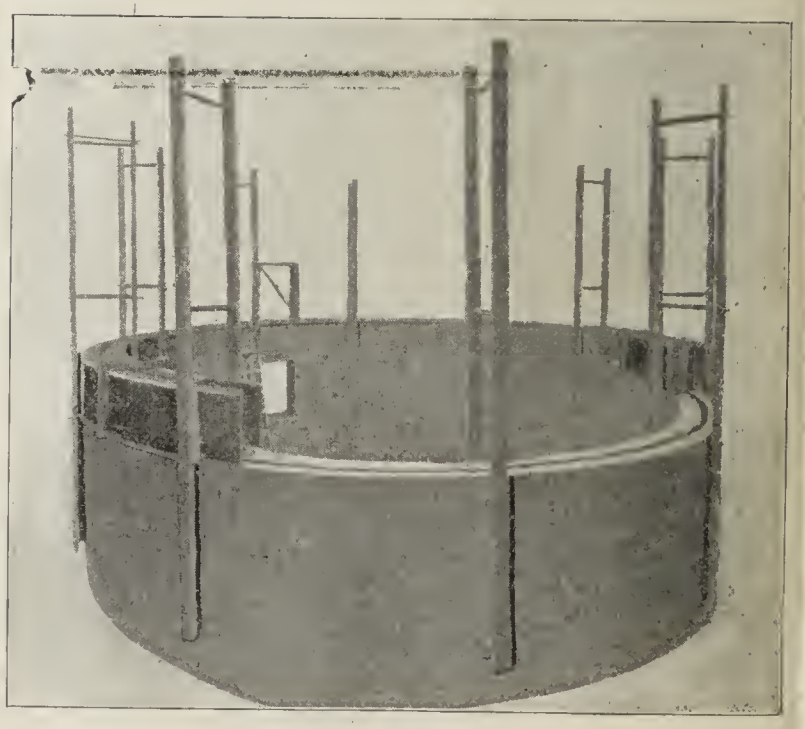
Throughout the northern section of the country and in Canada, the introduction of the hollow wall—continuous dead air space—in concrete silo construction has met with general favor and approval. The advantage of this form of silo is apparent to those living in a country exposed to very low temperature for prolonged periods of time. With proper attention to the closing of doors silage can be kept through the coldest winter without freezing. While the question of the use of frozen silage is still being argued by our able state experimental stations, it is certain that although freezing may not hurt the silage and may not be injurious to the animals that feed on it, it certainly does not add anything of value to the silage. This in connection with the trouble of thawing it out before feeding, makes the use of a silo that is proof against freezing of a decided advantage. Wood silos with double walls have been built throughout the Northern States in an attempt to prevent this freezing, but while they have succeeded fairly well in this feature, have failed by the rotting of the wood The silage juices get into the dead air space and rot out the wood in a remarkably short time. Careful ventilation during the warm weather may lengthen the life of the wood for possibly a year or two; even this ventilation will not prevent rotting for a longer time. The only advantage claimed for the best double wall wood silo—lined with cement plaster, has been its greater cheapness. With the reduction in cost of the concrete silo this advantage has now practically disappeared. This reduction in the cost of the hollow wall type is due to the use of reinforcement and of specially adapted forms for molding the green concrete. There are a number of companies operating who build the silo for the farmer or furnish the apparatus to contractors to build them, with full instructions as to how to build with his own labor. This saves considerable money on the item of labor alone. Among these companies is the New Enterprise Concrete Machinery Co., of Chicago. We are presenting an illustration of one of their silos with a description and illustration of how their forms are used. Figure 1 shows a silo built for Herman Barlow, near Greenwood, Indiana This silo gave Mr. Barlow as much satisfaction that he has since built another concrete silo of the same type, 22 ft. by 40 ft. inside measurement.

The above mentioned silo is of hollow wall construction, the inner wall being 4 in. in thickness and the outer wall 3½ in. while the air chamber is 3 in. The two walls are bound together every three feet (of height of construction) with ⅜ in. steel ties. The walls are reinforced with No. 9 fence wire, horizontally every foot to ¼ of height balance every two feet.

Figure No. 2 shows the patented construction forms used by the New Enterprise Concrete Machinery Co., They are collapsible steel forms. The outer forms are reinforced with angle steel and are held in position by gauges and keys. By a simple turning of the keys the forms are loosened or tightened. Turning the key half way around loosens the forms for removal or adjustment. The forms are 3½ ft. in height and have a variable circumference so that they can build a silo of any diameter.

These forms or machines are easily operated and common labor can do any part of the work in laying walls. No experts or high priced mechanics are required. Note in this illustration the ⅜ in. galvanized steel rods binding the two parts of the wall together.

A concrete silo.



Patented construction forms for building hollow wall concrete silos.

THE VAUGHAN SYSTEM OF REINFORCED CONCRETE CONSTRUCTION.

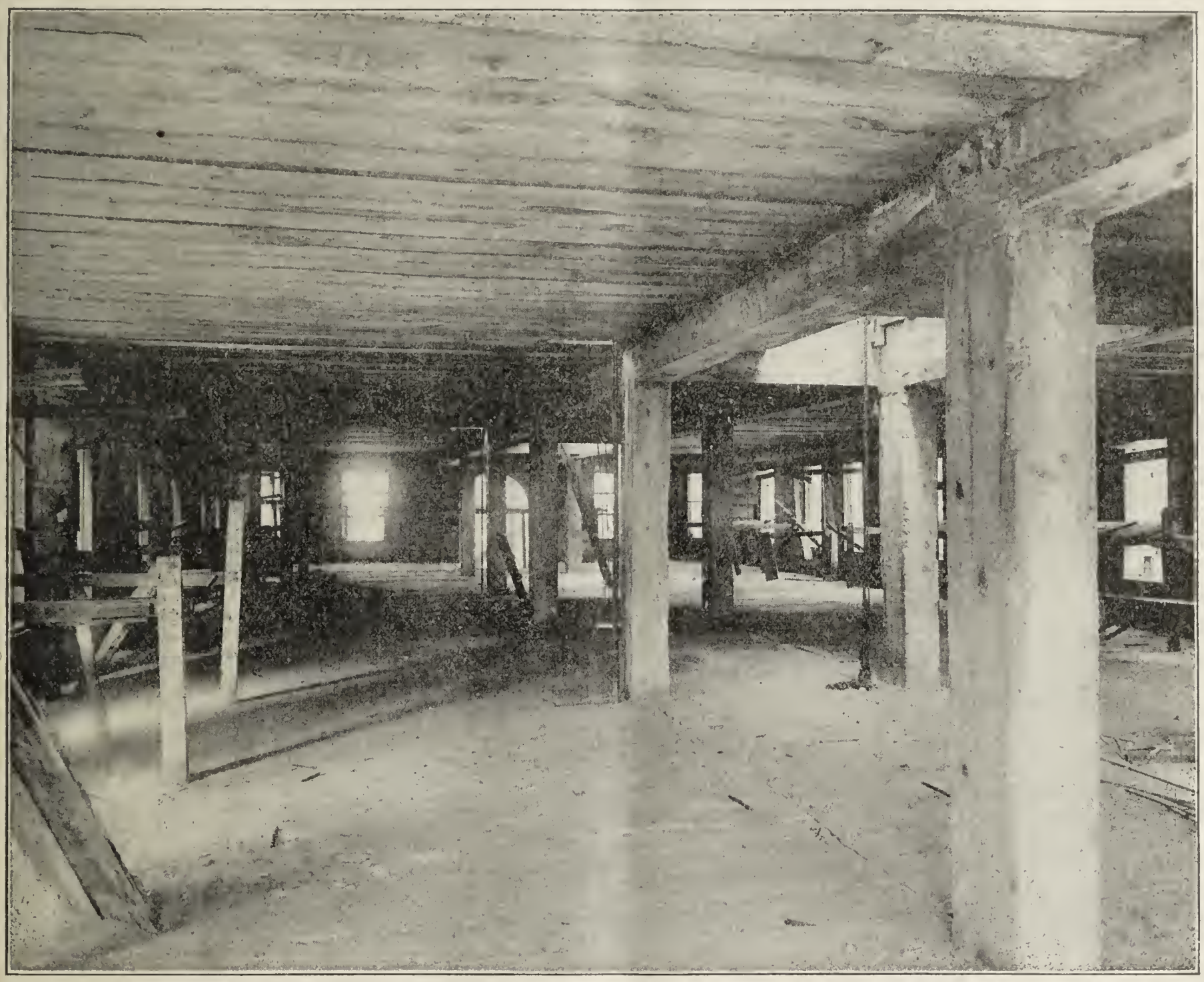
The use of concrete as a universal building material is conceded by all who have studied its nature to be only a question of time and of improvements on the present methods of handling. Cement, the bonding agency of concrete, has been so carefully studied, so extensively experimented and worked on by the best engineers of Amercia, and all of the processes of its manufacture subjected to such careful supervision, and handled by the best possible machinery, that all of the approved brands can be completely relied upon.

This article, however, has only to deal with floors, and it is in this instance that concrete offers as many, if not more, advantages as a building material than in any other place. As the floor of a building is virtually the keynote of fireproof construction, and at the same time has to support the greatest diversified kinds of loads, concrete by its great strength, its fire-resisting nature, and the flexibility with which it can be adapted to various forms and shapes, is the ideal material.

The drawback to a more extensive use seems to lie largely in the present seeming necessity of manufacturing or building the floor as one piece in the building. This monolithic method of floor construction has several disadvantages. At the present high prices of lumber and labor, the building and placing of the centering and staging, all preliminary but necessary work, is about as costly as the building of the floor itself. Then the excessive amount of labor required to transport the steel reinforcement, the tile or cinder filling and the wet concrete to position, and the very careful supervision and inspection to see that every portion is rightly placed, is always a source of worry to both architect and contractor. In large factory building, time is sometimes the most important consideration, and the forms and centering must be left in place from twenty to thirty days, retarding the rushing of interior work and also the building of the next story above, as the green floor cannot carry this weight until thoroughly cured.

All of these disadvantages have caused the building fraternity of this country to desire some sort of a concrete lumber, that could be secured in a ready-made state, in which the details of its manufacture could be in a way governed and handled like the manufacture of steel sections.

Realizing this need from a wide experience in concrete construction work, Mr. J. W. Vaughan, general manager of the Vaughan Company, of Detroit, designed the Vaughan System of portable concrete joists, which very closely meets this condition. These joists are a factory made unit of floor construction, each one complete in itself, and can easily be adapted to meet the requirements of each individual building. They are built in the shape of an I beam and are laid in the building with flanges touching, as shown in photograph No. 1, forming a continuous surface to receive the upper floor and a single coat of plaster for a ceiling.



View showing ceiling Vaughan System beams.

The various processes in the building and laying of a Vaughan System floor are exceedingly simple and very interesting. Probably the most important feature is the manner in which this work is governed. The Vaughan Company licenses the selling and manufacturing rights to one party in each territory, and keeps a rigid and personal control over this work, covering it with a very complete contract which specifies all the details of methods, material and product.

Any type of reinforcement, combining the use of horizontal tension and vertical sheer members can be used; it must, however, always be approved by the home company before installment.

As each section or "joist" is a complete portion of the floor and of a standard cross sectional it is cast separately. A wood or steel form is used for this purpose, consisting of a heavy plank with a planed surface for a pallet and separate side members of wood or pressed steel, allowing it to be easily removed from the cast joist.

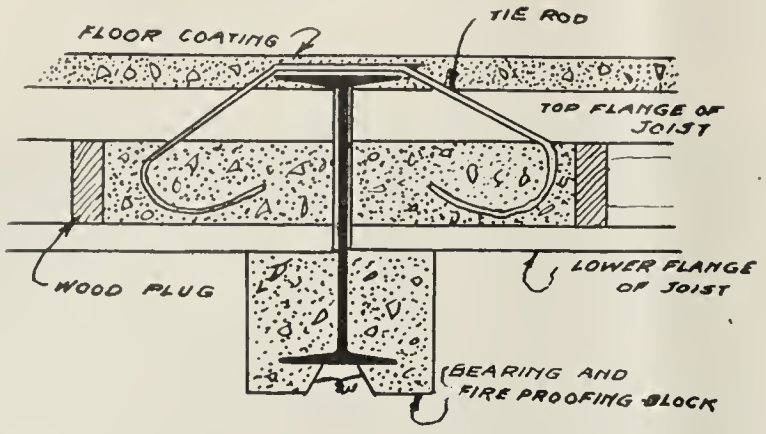
A very wet mixture of approved materials in the proportions of one part cement, two parts sand and four of stone is used. This is poured into the mold until it reaches an exact height of one inch. On top of this are placed the reinforcement rods, which are self centered so that they are always in the exact required place Then the form is filled with concrete which completes the exceedingly simple operation of manufacture.

The joists are left in the forms for a sufficient time for them to set and then are piled away for a period of twenty-five or thirty days, according to the weather, when they are thoroughly cured, ready for use.

As each joist is cast, a serial number and the date are stamped into it, so that the architect has an exact check on the age of each beam. The serial numbers carefully recorded in a permanent record kept at the home office of the Vaughan Company giving them, with the other information registered, a complete history of every floor built by their system.

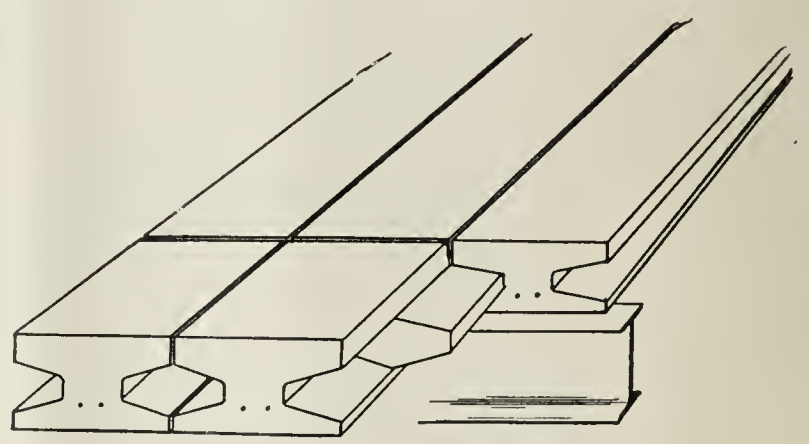
The company claims several distinct advantages.

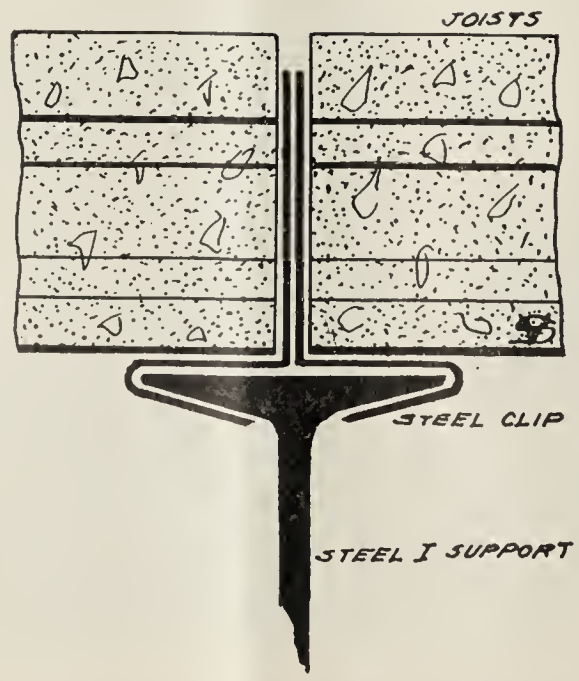
As the T action is used as the theoretical basis of strength calculation in practically all classes of concrete floor construction, they hold that it gives to the architect and engineer the theoretical form as an actual shape and complete unit.



As a ready made proposition and fully cured before going into the building, he has an unlimited opportunity to inspect and test the joists, eliminating any doubts he may have as to strength and perfect workmanship.

A factory made article, the company declare, is always better than one that is made on the job, as the work is divided into distinct departments, each one having the same men doing the same work each day, making them experts in their portion of the work, and as it is all superintended by competent and carefully trained men held under rigid control, the architect has every assurance that the product is satisfactorily made. The company contends that the architect has placed before him a reinforced concrete unit of standard cross section, of which all the characteristics are known, manufactured in a properly equipped plant of the best possible materials in a scientific manner, similar to the way steel beams are now manufactured. The company also claims that their system gives the architect the chance to specify reinforced concrete floors in repairing and rebuilding work, where time is an important factor, and that he can secure his floor from stock, already completed from the yards, and lay it right in place.





A test recently made in Detroit on two beams only twenty days old, showed some rather remarkable results. The beams were 8″ x 12″ sections, reinforced with two half-inch Gabriel Full Trussed rods, having been designed to carry 60 pounds live load. The first day of the test the beams were loaded with concrete blocks weighing 50 pounds each until a load of 160 pounds per square foot was placed. This load was allowed to remain twenty-four hours, when the beams showed a deflection in the centre of 3/8″. It was then increased to 518 pounds per square foot giving a deflection of 1 7-16.″ Very careful examination failed to show any cracks or checks whatever. About eight hours later the load was still further increased to 570 pounds per square foot, which gave a deflection in the center of 1 11-16.″ Three or four very fine cracks then developed in the lower flange of only one joist, and but one of these was near the center, this one extending into the web a very short distance. As this load touched the roof of the shed in which the test was being made it was impossible to increase it. The next day observation showed the deflection to be 2 1-16″. This load was then allowed to remain until two days later, when a further observation showed the deflection unchanged and no further cracks. The load was removed and the joists came back to one inch deflection, otherwise appearing unharmed. The

most remarkable part of the test was the fact that a tension on steel of 80,000 pounds per square inch was shown and a compression of the concrete of 1,695 pounds per square inch.

Mr. Vaughan, in working out this system, states that he has tried to cover the five important points in any class of construction work—simplicity, reliability, flexibility, economy and availability, and up to the present time no case has been found where these points were not amply covered to meet any condition.

Regardless of what class of building you are going to erect you have thoroughly satisfied yourself that it should be absolutely fireproof. If you have decided to use the non-fireproof variety of wood construction undoubtedly it is because of the excessive first cost of building in concrete.

The few objections which the uninitiated have against concrete have been the results of amateur work. The many beautiful and perfect structures of concrete which have been erected by competent engineers and experienced contractors are sufficient to convince the most skeptical that concrete is the ideal and future universal building material.

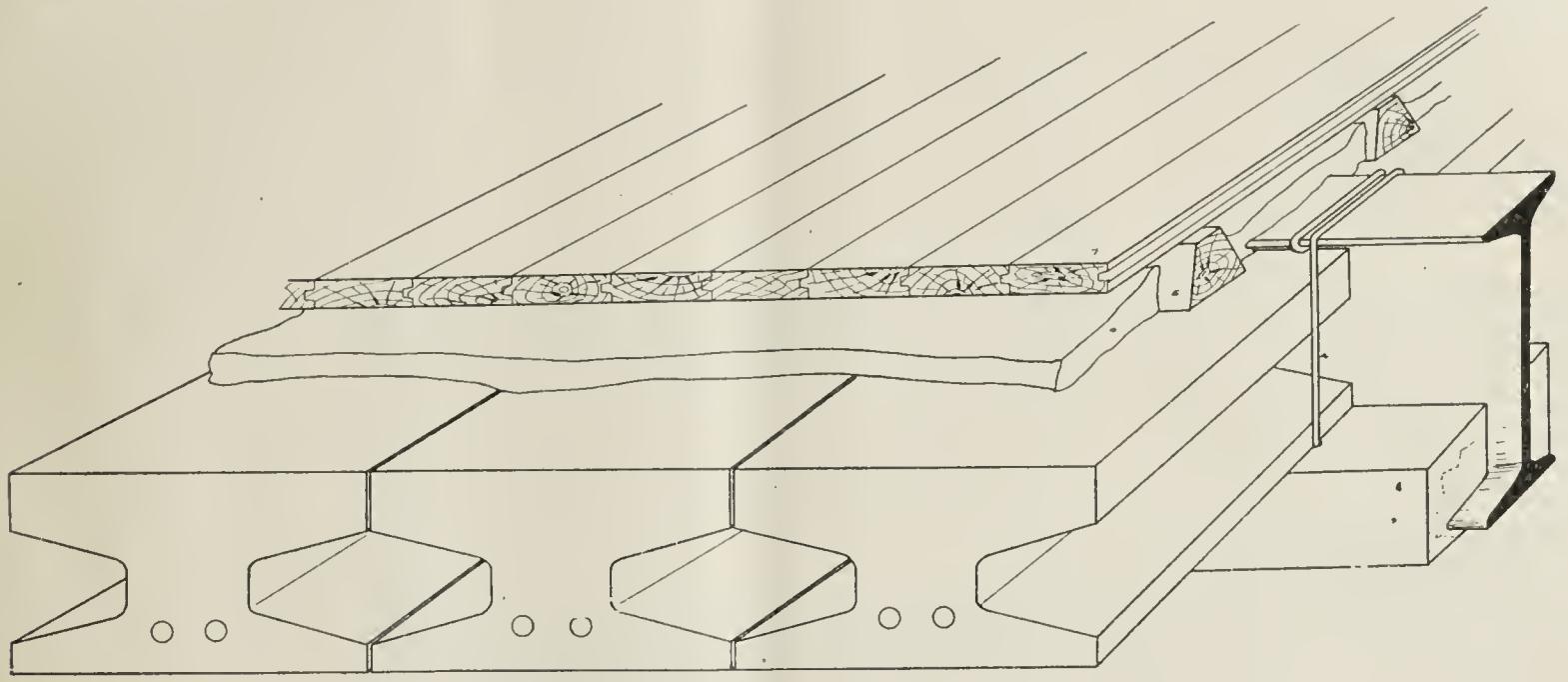
It comes the closest to being nonburnable of any known building material and when the larger portion of the building is of concrete it may well be called "absolutely fireproof." Concrete is the most permanent of building materials and its use in the erection of a building eliminates repairs. Concrete structures, when properly made, are dry, entirely impervious to vermin, are more easily heated in the winter time, and are cooler in hot weather.

The floor of your building—the key note of fireproof construction—has been the most expensive part of the structural portion of the building when made in a monolithic form or as one piece as is now necessary, caused by the extraordinary amount of labor, the great amount of care required in the placing of reinforcing steel, the absolute necessity of expert selection and mixing and materials and the expensive temporary false work on which to pour the concrete and the long time required for the concrete to thoroughly cure. These items have raised the cost way out of proportion to the other parts of the building.

The Vaughan System of fireproof floor construction, the improved adaptation of several successful foreign unit systems, offers you, for the first time in America, a ready-made standard form of concrete floor sections with a flexible enough design to be accurately adapted to meet your conditions.

The Vaughan System consists of complete reinforced concrete units or "joists," built in the shape of an exaggerated "I" beam. Several standard cross sections have been devised, each having their own carrying capacity for different lengths of span so that the selection of the proper joists is as simple a matter as the selection of a steel beam.

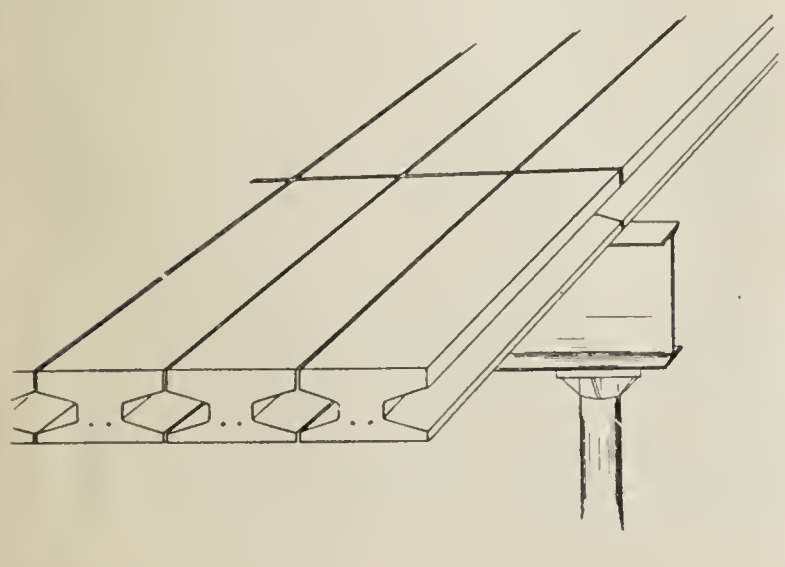
The joists are laid in the building with the flanges touching, forming a

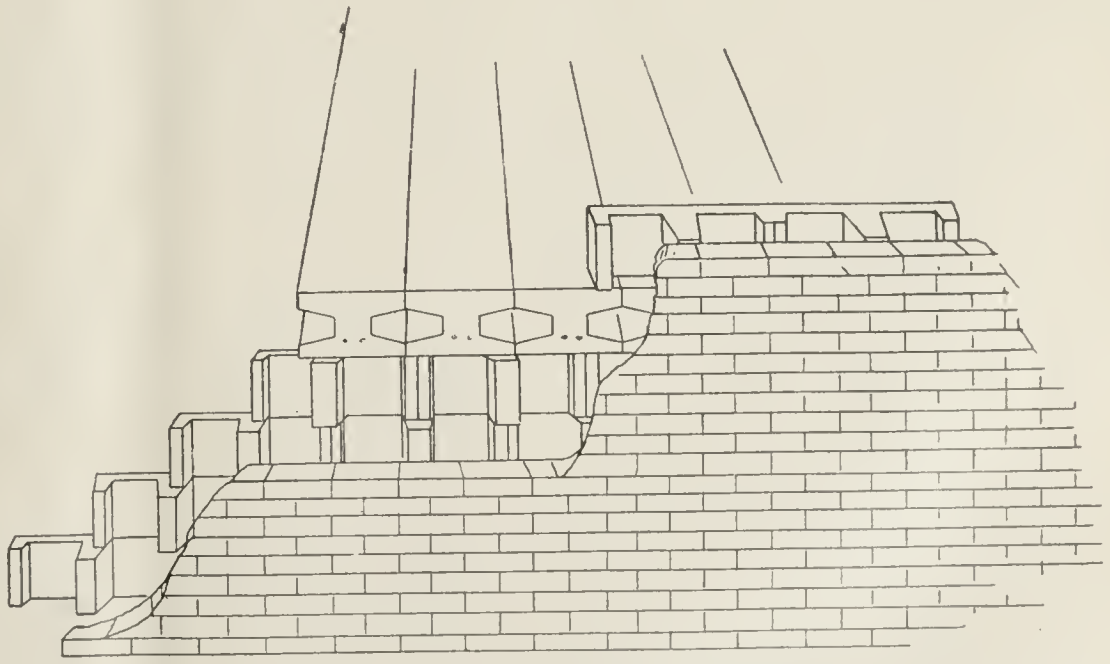


continuous and complete surface on top to hold the finishing floor. Any type of floors, plain cement finish, tile, granolithic or wood floors can be readily laid on the joists.

The underside of the joists forms another complete and continuous surface for the ceiling, requiring but a single coat of rough plaster on which to place the final finish.

The hollow space between the joists





VAUGHAN SYSTEM FLOORS
VENEERED BLOCK WALLS.

forms a convenient space for the laying of pipes, wires, etc., as well as providing a large air space which prevents dampness, soundproofs the floor and acts as a non-conductor for heat and cold.

The use of this system does not limit in any way the other structural features of the building. Any wall can be used except the ordinary wood studding which, of course, would not be suitable for fireproof floor construction. The use of two-piece concrete blocks, using them only on the inside as a bearing wall for the joists, makes a specially good and cheap wall. The outside may be veneered with brick, concrete blocks or tile, or finished with metal lath and stucco, as may be desired.

For intermediate supports a simple construction is the use of steel "I" beams and cast iron columns. We have a simple wet-cast concrete block for the fireproofing of beams when required.

There are several reasons why the cost of fireproof floors by the Vaughan System is greatly reduced. The entire elimination of false work and centering, the economical design of the joists that secure the greatest amount of strength for the minimum amount of materials and the great reduction in the handling of raw materials remove a large percentage of the cost of concrete floor construction.

It is impossible to give definite figures for all localities as the price of materials and the labor conditions vary greatly. Prices will be furnished for use for estimating and the correct prices will be furnished upon receipt of plans and specifications or description of the building and any special conditions that must be observed.

The small amount which they may run above non-fireproof construction is hardly worth considering when taken in proportion to the cost of the building and the proportionate reduction which can be secured in fire insurance votes and the increased safety.

A concrete sewer six miles long, 10½ feet to 4 feet, will be built by the city of East St. Louis, Ill. The O. T. Dunlap Company, Edwardsville, Ill., have been awarded the contract. About $700,000 will be expended and includes about 30,000 cu. yds. of concrete masonry.

Sterling Construction Co. of Newark, N. J., has been incorporated with a capital of $100,000. The incorporators are: Roland D. Crocker, Henry H. Poole and Edward F. Wheelan. The company is to do a general contracting and construction business.

CEMENT COMPANY REORGANIZED.

Los Angeles, Cal.—The Victor Portland Cement Company has reorganized by electing new officers and directors. The officials of the company comprise business men of integrity and high standing in this community. The new officers are:

President, D. A. Mulvaine; first vice-president, Lycurgus Lindsay; second vice-president, F. E. Engstrum; third vice-president, Richard Lacey; secretary, J. G. Meachem; treasurer, Ora Monnette.

Fifteen directors were elected, as follows:

Reese Llewelly, F. E. Engstrum, F. H. B. Banks, L. L. Elliott, Edward Groenendyke, Orra Monnette, Richard Lacey, J. G. Meachem, C. C. Kohlmeier, J. J. Abramson, D. A. Mulvaine, Lycurgus Lindsay, Aman Moore, Harrison Albright, A. A. Baird.

This company is capitalized at $1,000,000, and will build one of the most modern cement plants in the country at Victorville, in San Bernardino County. The plant will cost $1,000,000. The deposits of the company are fourteen miles from Victorville, and work has been commenced on a railroad running from Victorville to it. The road will cost $500,000.

When the company was organized it announced that no money would be spent until assurance was at hand that the entire amount could be raised. Through Mr. Vincent of the Columbia Trust Company more than $1,000,000 worth of stock has been sold, and it is said he will dispose of the remainder in a few weeks. He will leave for the East in a few days to close the negotiations.

The Twin City & Lake Superior Railway, Railway Bldg., Minneapolis, Minn., who are to build a line from Minneapolis and St. Paul to Duluth have just awarded the contracts which include the construction of three steel and concrete bridges, one 1,300 feet long and the other two 300 feet each; also 10,000 cu. yds. concrete masonry.

The Francis Mills Cement Co., of Chicago, Ill., has been incorporated to deal in cement and do general contracting, by Francis Mills, Bohumil J. Wacek and James F. Forsythe.

Ludwig B. Larsen, David Goodell and J. Larsen have filed articles of incorporation of the Oregon Concrete Block and Machine Company, with a capital stock of $25,000, at Portland, Ore.

PLANT CHANGES HANDS.

The Alpha Portland Cement Company has purchased the Buckhorn Portland Cement Company's plant at Manheim, W. Va., for $500,000. The company will spend $250,000 in improvements. When these improvements are completed, the plant will have a capacity of 3,000 barrels a day. The Alpha Portland Cement Company is running all of its mills and finds the demand increasing with the opening of the spring season.

ANOTHER LARGE EASTERN PLANT.

Interests closely allied with the Atlas Portland Cement Company, of New York, have purchased the entire plant of the Hudson Portland Cement Company at Greenport, near Hudson, N. Y., and will at once begin the work of complete reconstruction of the present property. This purchase includes the plant at the Hudson river, the railroad and all of the quarry land, comprising 1,400 acres. When the plant is completed it will have a capacity of 5,000 barrels per day or more. All the latest improved machinery known in cement making will be installed in this plant. The construction of the plant is in the hands of W. S. Tyler, who has a corps of competent assistants who have been brought from the Northampton mill of the Atlas company. The acquiring of this property and mill makes this the third one owned by the Atlas Company, and with the added capacity will augment their position as the largest manufacturers of Portland cement in the country. Being one of the pioneers in the maufacturing of cement, they are enabled by their experience to construct a mill which should be a model.

Within three or four months the Golden State Portland Cement Company, with offices in the Citizens' National Bank Building, Los Angeles, Cal., expects to have its big cement plant at Oro Grande turning out cement. Work on the buildings and machinery is progressing rapidly, and the first unit, with a capacity of 700 barrels a day, will be completed soon. The drier building has been completed, and the big drier was placed in position in it a few days ago. The kiln building is now in course of erection, and the brick for the interior of the smokestack will be delivered shortly.

The Colossus Cement Company has been incorporated at Trenton, N. J., with a capital of $4,000,000, to manufacture cement. Incorporators: William H. Williams, F. Winthrop White and Robert V. Kelly, all of Jersey City.

HE LOS ANGELES AQUEDUCT.

obably no greater feat of hy- ic engineering has been at- ted in this country than the pro- undertaken, scarcely a year ago, cure for the City of Los Ange- Cal., a water supply from the -fed Owens River and its tribu- s by means of a 230-mile aque- which will bring 400 cubic feet are snow water per second into ity. It was undertaken by Los les in that spirit which domi- the master minds that know no re. This tremendous work, in- ng a present expenditure of 00,000 and an ultimate outlay 30,000,000, has been grappled and is now reduced to a mere l.

e line of the aqueduct covers a nce of approximately 230 miles. ill require under favorable cir- tances, between four and five to complete it. The work is now tive operation. A brief history e enterprise will show what has done and is yet to be accom- d.

e question of an adequate sup- f water for a rapidly growing lation is one of the largest with n a modern American munici- has to deal. This important r received due consideration at hands of the Board of Water nissioners of Los Angeles, as ack as February, 1902, prior to the water supply was con- d by a corporation called the Angeles City Water Company. new order of things brought changes and improvements. of new pipe mains were laid et the extraordinary growth of ity and eventually the demand for an additional water supply. 1907 the source of supply was os Angeles River, by means of els, wells in the river bed and ian wells in the southeast. The was growing so rapidly that it ved upon the superintendent of water department to develop possibility of augmenting the y from wherever obtainable and ovide for the wants of a city ng at a rate of 30,000 persons ear.

rious consideration was first to the possibility of increasing upply from Southern California, this was found not practicable attention was then directed to Owens River Valley, situated in county, California. Although a ne of great magnitude, requiring utlay of millions of dollars and of work, the matter was boldly oached by the board's officials the general surveys and inspec- undertaken. Many trial routes necessarily were surveyed, costs estimated, advantages compared, etc., before the most economical location necessary for the aqueduct were finally laid down. A Right-of-Way Act was passed by the proper authorities which granted the City of Los Angeles the right of use of public lands required for canals, reservoirs and power plants in Inyo, Kern and Los Angeles counties, subject to valid existing rights and giving certain privileges in the matter of maps and field notes and making various restrictions as to right of disposal of water. In cases where riparian rights were in the hands of private owners, purchases were made by the city.

For facilitating the work the line of the aqueduct has been separated into ten sections or divisions, each of which is approximately twenty-three miles long. In the organization of the work a division engineer will be placed in charge of each of these sections.

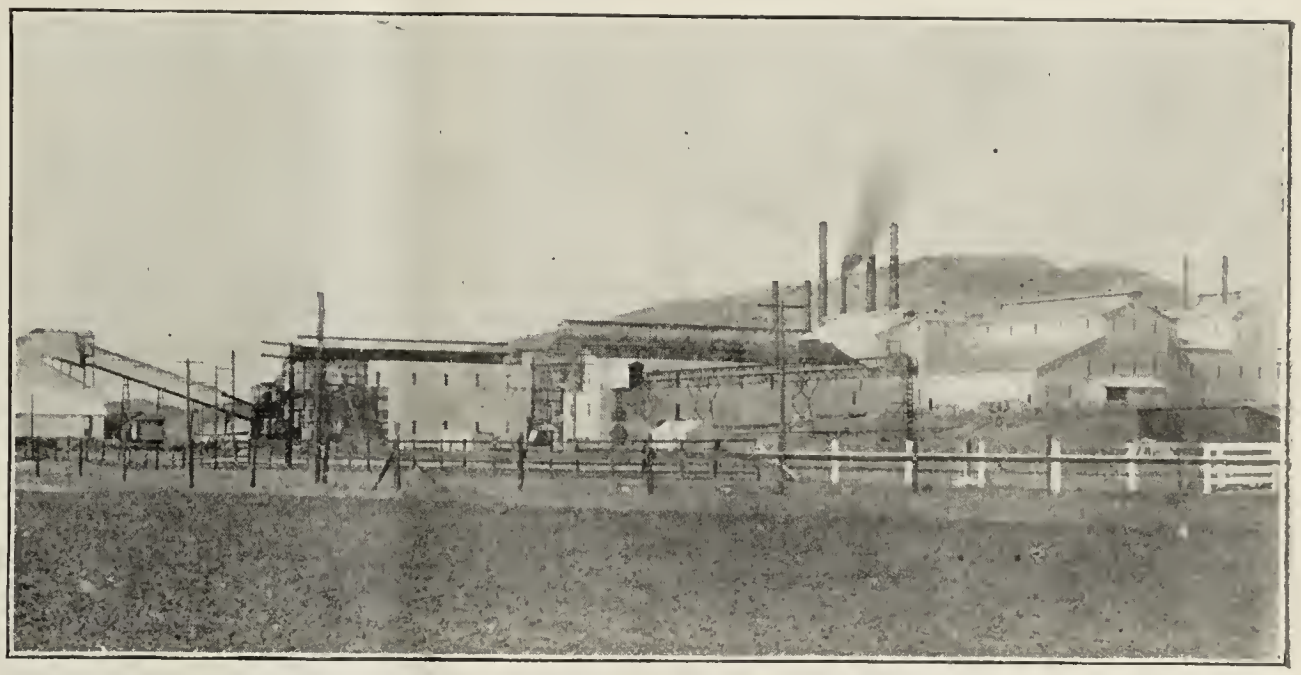
While there are, of course, many engineering difficulties in the undertaking, there is nothing that the officials in charge are not capable of surmounting, the worst feature being the natural conditions which operate against transportation, communication, etc., but these are being or are practically overcome.

The isolation of parts of the aqueduct from railroad facilities, resulting in an excessive cost of delivering materials and supplies, and the large expense of power generated by steam at practically all parts of the line are two of the chief difficulties to be overcome in the construction.

The Southern Pacific Railroad has a narrow gauge line extending down the Owens River valley from a connection with the Central Pacific Railroad in Nevada, and this line is the only railroad in that region. Although the narrow gauge line parallels at a distance of 3 to 5 miles the canal which will form the upper 30 miles of the aqueduct, it terminates on the opposite side of Owens Lake from the Haiwee Reservoir site. From this terminus to Mojave, a distance of 120 miles, no railroads exist and the aqueduct location is through a barren desert country. Bids for hauling materials and supplies through this region have been invited twice, the tendered price on both occasions being 28 cents per ton-mile. Since the necessary haulage is estimated to average 2,500 tons per mile of aqueduct, the cost of wagon transportation in the flat, desert region would exceed the cost of building the aqueduct.

In the unoccupied desert region between Mojave and Owens River, where forage and subsistence supplies all have to be brought in, the cost of feeding a horse is from 50 to 70 cents a day. The cost, transportation and maintenance of labor are also high.

In building a work of such magnitude it necessarily followed that the question of adequate and cheap power to use in excavating, to drive the tunnels, and to hoist material up steep mountain sides was of prime importance; but the large expense of power generated by steam at practically all parts of the line seemed to be a serious difficulty to overcome. These considerations very early suggested the advisability of using electricity as the motive power. Current is to be furnished eventually from hydro-electric plants built along the line of the equeduct, the output of which can be used wherever needed to drive the construction plant. But the chief source of electrical energy from the first will be from the mains



The Aqueduct cement mill.

of the Los Angeles Edison Company, whose high voltage transmission lines extend to the city of Los Angeles from the Kern River hydro-electric plant, owned and operated by the company. Ample power will thus be obtained for the entire project, and this power can be delivered over transmission lines so readily that any other method of supplying power would not compare in cost and convenience.

In many respects the Kern river development is unique. It is claimed to be the largest hydro-electric plant west of Niagara. The transmission line of 117 miles is one of the longest in the world. The pressure of 75,000 volts over such a length of cable is among the highest ever attempted. The conduit which leads to the pressure main is the longest underground tunnel system in use for this purpose. The concrete encased penstock, from which the supply will come, is said to be the first of its kind ever placed in service.

The four wheels which convert hydraulic to electrical energy, were built by Allis-Chalmers Co., of Milwaukee, and have each a capacity of 10,750 h. p. at full nozzle opening and a speed of 250 revolutions per minute when operating under a net effective head of 865 ft. In addition to the main turbines there are two exciter turbines, also of Allis-Chalmers design, each with a capacity of 450 h. p. and a speed of 430 revolutions per minute. The turbine units are of the impulse type, with hand adjustable needles and governor-operated deflecting nozzles. Each unit has two runners, one on either end of the generator shaft. The interchangeable buckets are made of non-corrosive phosphor bronze of special mixture for the high head and are attached to the cast steel discs bolted to the flanged ends of generator shaft. The nozzles are provided with hand adjustable needle and arranged to be deflected by the governor automatically, or by the latter's hand-regulating device. By deflecting the jet, instead of regulating its discharge by adjusting the needle with the governor, it is possible to secure a constant velocity of water in the pipe-line, as well as a constant discharge of water into the tailrace, even when the plant is operating with heavy fluctuations of the commercial load.

is but one of three water power developments owned by this company, in addition to six or seven steam plants located within a radius of 200 miles, all of which will operate in synchronism. A portion of the output of this plant is disposed of along the line to Los Angeles. A very considerable amount of power will be utilized in the city of Santa Barbara. The demand for power in Los Angeles, Santa Barbara, and San Luis Obispo counties far exceeds the supply, and the output from this station helps to satisfy the general requirements rather than being devoted to any specific purpose. The Edison Company contemplates the building of plants No. 2, 3 and 4 on the Kern river, which will aggregate over 100,000 h. p. in addition to the output of the previous station.

One of the most important portions of the work is that of the Elizabeth Lake tunnel section. It is being cut through the crest of the Coast Range and will have a length, when completed, of 26,863 feet. It is to be 14 feet by 14 feet throughout. The work is being carried on night and day from both ends and was begun in October, 1907. On August 1, 1908, there had been 2,700 feet of the tunnel opened up. There are at present 125 men employed thereon. This section practically dominates the length of time the whole work will take, as all other sections can be completed by the time this tunnel is completed.

At the north portal, 68 miles from Los Angeles, a model tunnel plant has been erected which consists of a power house, machine shops, blacksmith shops, warehouse, mess hall, bunk houses, offices, hospitals, residence of superintendent, besides stables and out-houses, all equipped in the most modern manner. At the south portal, five miles south of the above, a similar plant has been erected, so that everything possible has been done to facilitate the work which is going on.

Within a short time active work will begin on the Haiwee reservoir. This is the most important reservoir site on the line of the aqueduct, as it affords a means of direct equalization of the flow of the main canal and the streams gathered by the canal.

The reservoir is situated on a summit in the valley from which the natural drainage is in both directions, north and south. It has a length of 7.4 miles measured along the thread of the valley, and is to be formed by dams at each end, the south dam being the larger of the two, 70 feet in maximum height with a top length of 900 feet. The north dam is longer but has a height of but 30 feet.

The capacity of the Haiwee reservoir at the elevation of 3,760 feet is computed at 63,780 cubic feet. It is estimated to cost about $317,000.

The aggregate length of the aqueduct may be summarized approximately as follows:

	Feet.	Miles Per
Conduit unlined canal	117,200	22.20
Conduit lined with rubble masonry or concrete	868,700	164.53
Tunnels in rock	96,295	18.24
Tunnels in earth	53,370	10.11
Syphons of steel crossing canyons.	47,460	8.99
Steel flumes crossing shallow and narrow depressions	9,510	1.80
Total	1,192,535	225.87

The conduit has been estimat with a cover of reinforced concr for a distance of 100,440 feet 11.6 per cent of the entire lined s tion, the remainder to be left o for the first five years of operati

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One of the largest contracts cement ever placed in the Domini of Canada, has just been placed the Frank B. Gilbreth organizati with the Vulcan Portland Ceme Company, whose works are Longue Pointe, Quebec, throu their agents, the William G. Ha ranft Cement Co., Ltd., of Montre Canada, for the immense hydr electric development on the St. Jo river at Grand Falls, New Bru wick. The order covers the enti cement requirements for the wo and will amount to nearly 100,0 barrels of cement which will be test at the company's storage bins, whe it will be reserved under seal a shipped in carload lots to the job required, thus assuring the contract that the cement will be up to t standard requirements when ceived. The placing of such a lar order for cement with Canadian pe ple, indicates the attitude of the co tractor in placing all orders for m terial, as far as possible, with Ca adian interests.

The Elyria Concrete Company h been incorporated at Elyria, Oh with a capital stock of $25,000. T incorporators are C. W. Whales, C. Griswold, H. W. Ingersoll, F. Stetson, G. R. Allen.

The Italian government has plac contracts for 300,000 reinforced co crete railway ties at $1.25 pr. tie, o tie in each thousand will be tested breaking to examine the bond betwe the concrete and steel, as well as t quality of the material composing t concrete, a one year guarantee is r quired for the ties. The Italian sta railways have been using concrete ti for over five years with entire sati faction.

THE AQUEDUCT CEMENT MILL.

The estimates of the quantity of ment required in building the Los ngeles aqueduct provide for the nsumption of 1,080,000 barrels. or the first stages of the work, such foundations etc., bids for supply- g 30,000 barrels of cement were lled for. The California Portland ement Company, of Colton, Cal., as the successful bidder, at a cost $1.75, f. o. b., Colton, per barrel aking the cost $2.13 delivered f. b., Mojave. Mojave has been ade a terminal point for aqueduct eight. Warehouses and machine ops have been built and headquar- rs have been established there.

A complete investigation of the vailable natural limestone and clay eposits along and adjacent to the queduct was therefore made and stimates of the cost of manufactur- ng cement were carefully prepared. As the result of these investigations

A view of kilns furnished by the Vulcan Iron works of Wilkesbarre, Pa.

a deposit of clay and two deposits of limestone were purchased. The clay bed covers about 300 acres along the Southern Pacific Railroad, five miles east of Tehachepi and fifteen miles from the line of the aqueduct. One of the limestone deposits covers 110 acres, six miles from the clay bed, and the other, 160 acres, three miles from the clay bed. Estimates based on the cost of erecting a cement mill capable of producing 1,000 barrels of cement a day from these deposits showed that the cement could be made at about $1.05 a barrel, and could be delivered to the line of the aqueduct at Mojave for $1.24 a barrel.

The decision was, therefore, made to build a mill capable of producing 1,000 barrels of cement a day, so contracts were awarded for the necessary equipment.

In January, 1908, the site of the municipal cement factory, which is the first ever erected by a municipality, and it has also the record of being the second plant erected for the purpose of completing a special work, was bare of any improvements, and there was no house nearer than a mile, that was available for housing any mechanics. A farm house was rented, and about fifteen carpenters and laborers commenced work on February 1, 1908, building bunk houses and a mess hall at the new mill townsite, located five miles east of Tehachepi on the Southern Pacific Railroad. Grading teams commenced grading for yard trackage and at the same time to provide facilities for unloading machinery.

Early in March, bunk houses, office buildings and railroad sidings were completed, and the numbers in the construction gang were increased. Active construction work on foundations was initiated and machinery began to arrive and be installed, so that at the present time of writing, active construction work may be said to have been in progress for a little over ten months.

The city owns three limestone properties, and during the past year prospect work has been done on all three deposits, demonstrating that the South Quarry, located six miles southwest of the mill and covering 120 acres, is the largest and most uniform and contains the highest grade limestone. This deposit has been adopted for supplying limestone for the mill. A quarry has been opened on the side of the hill, eight hundred feet above its base.

In order to bring the limestone from the quarry to the base of the hill, an aerial wire rope tramway was installed, having a length of approximately 4,700 ft., and a difference in elevation in favor of the loads of somewhat more than 800 ft. In order to transport this limestone at as low a cost as possible various styles of aerial tramways were considered, with the final result that the patent special automatic system manufactured by A. Leschen & Sons Rope Company, of St. Louis, Mo., was adopted.

There are a total of 32 carriers, each of which consists of a bucket holding 10 cu. ft. of limestone, and which travel at a speed of 300 ft. per minute. A carrying capacity of 30 tons per hour is thus secured, which is handled by one tramway operator. The carriers are permanently attached to the traction cable and are loaded by means of a mechanical loader, while at the discharge terminal they are automatically discharged while traveling around the terminal rail.

The bucket returns to the loading point up-side-down, but as it travels around the loading terminal it is mechanically righted by means of a righting device installed at this station.

In order to support the cables midway between stations, 17 supporting towers were installed, located at convenient points along the line. At each tower the track cables rest on saddles, while the traction rope is guided by sheaves or rollers.

All of the ropes used are of the Patent Flattened Strand Crucible Steel construction and quality, manufactured by A. Leschen & Sons Rope Company, the cable on which the loaded buckets travel being 1⅜″ diameter, while that on which the empty ones return is 1″ in diameter. A ¾″ traction rope is used, which passes around a 10 ft. sectional grip wheel at the loading terminal.

This construction of rope presents a smooth wearing surface, which minimizes wear on cable and trolley sheave wheels on the carriers. The track ropes are securely anchored at the upper end of the line, while at the discharge terminal they are attached to weight box tensions so as

to unify the stress in the cable, irrespective of load.

The grip wheel at the loading terminal, and consequently the speed of the tramway, is controlled by three brakes having their lever connections so arranged that the single operator handles the brakes as well as the chutes supplying the loader.

The bin into which the limestone is placed at the loading terminal is a little under 100 tons in capacity, while the discharge terminal bin, into which the buckets discharge their material, is approximately 250 tons in size.

From the tramway the limestone is carried five miles to the mill by narrow gauge locomotives furnished by Vulcan Iron Works of Wilkes-Barre, Pa.

The limestone is dumped to a McCully Gyrating crusher, furnished by the Power & Mining Machinery Company of Cudahy, Wis. Belt conveyors furnished by the Webster Mfg. Co., of Chicago, carries the crushed rock to the storage bins.

The clay is brought from the beds a mile away by an aerial tramway 5,800 feet long. A belt conveyor furnished by the Webster Mfg. Co., of Chicago, carries the clay to the storage bins. From the storage bins the limestone and clay pass through individual dryers furnished by the Vulcan Iron Works of Wilkes-Barre, Pa. The limestone passes from the dryer to Krupp ball mills, and from these mills to the hopper over the measuring device. The clay passes through a Sturetvant rock emery mill and then to the hopper over the measuring device.

The Trump Proportioning and Mixing Machines furnished by the Conveying Weigher Co., 90 West street, New York City, is used for proportioning the materials, which is a unique machine, inasmuch as it proportions the limestone and clay in the raw mixture accurately and continuously, requiring scarcely any attention. The chemist can adjust the proportioning device and lock it so that it remains as desired, until altered. From the proportioning machine the mixture passes to Krupp tube mills. The elevating and conveying machinery was furnished by the Webster Mfg. Co. From the tube mills the material passes to concrete storage bins over the kilns. Three kilns, each 125 x 7½ feet, are used for burning. The kilns were furnished by Vulcan Iron Works, Wilkes-Barre, Pa. Crude oil is used for fuel.

An improved feature of the plant is the fuel economizer installed at the kiln stacks and furnished by the Green Fuel Economizer Company of Mattewan, N. Y., which were installed for purposes of using the stock gases from kilns to heat the boiler feed water for the power plant. By this installation it is expected to reduce cost of power by 12 per cent.

The clinker drops from the kilns into rotary coolers furnished by Vulcan Iron Works, and is conveyed from the coolers to the clinker storage room by a pivoted pan conveyor furnished by the Webster Mfg. Co., of Chicago, which conveyor returns by a tunnel carrying cool clinker to the grinding room.

Krupp ball and tube mills handle the finishing of the cement. A Williams mill, furnished by the Williams Crusher & Pulverizer Co., of Chicago and St. Louis, reduces the gypsum, and a Trump measuring machine handles the proportioning of the cement and gypsum.

The cement is handled by a belt conveyor to the stock house. The elevating and conveying machinery of the entire finishing end was furnished by the H. W. Caldwell & Son Co., of Chicago. The plant is operated by Curtis steam turbines direct connected to two 500 k. w. generators furnished by the General Electric Company of Schnectady, N. Y., and of special construction calculated to carry 50 per cent overload continuously. The Westinghouse Company furnished the individual motors for operating all the equipment. Four Bonus water tube boilers, furnished by S. Freeman & Sons Co., Racine, Wis., furnish steam for the turbines. They have a total of 1,500 boiler horse power.

Mr. E. Duryee, formerly in charge of the Government cement plant at Roosevelt, Arizona, is the expert in charge, while Mr. G. A. Fisher, formerly with the California Portland Cement Company, Colton, Calif., is superintendent of construction.

THE HERCULES CEMENT STONE MACHINE.

The Century Cement Machine Co. of Rochester, N. Y., has published a handsome aluminum bronze covered book 7½ x 10 inches which describes and illustrates the various kinds of machines made by the company for the manufacture of concrete building blocks, cap sills lintels, water tables, columns, balustrade; in plain rock faced and ornamental styles, Hercules Tampers, and all kinds of cement workers tools of the latest design. The Hercules machines are strong, simple in design and easy to operate, and produce first class concrete work. The Century combinal curb and ter for Municipal is just what tractors doing street work req The Century Cement Machine make it a point to produce only class machinery and appliance, are therefore perfectly trustwort

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THE PORTLAND CEMENT INDUS FROM A FINANCIAL STANDPOIN

By Edwin C. Eckel.

93 pages 9x6 in cloth bound, $2.00, Moody's Magazine, 35 sau St., N. Y., Publishers.

This book presents a review the growth of the American Cen industry from a financial stand pc and is designed to assist investors gaging the value of cement securi offered in the market, by submitt facts and figures on the cost of p duction. Elements of plant locati value of raw materials, full suppl markets and transportation facilit dealing with over capitalization a methods employed by unreliable ment plant promoters and market of securities, based upon false a exaggerated statement as to the c of production and selling price the finished product.

The book contains numerous tab showing the actual cost of producti of Portland cement, with the fluct ation of prices from 1870 to 19(Tables showing the production in ba rels in the U. S. and value of t output for each year from 1870 to i cluding 1907. The book is full data useful to the financier looki for investments in cement securitie Mr. Eckel is well qualified to de with this subject as an expert, wl has made a close study of the ceme industry, while in charge of the c ment on the U. S. Geological Surve as well as being the author of C ment, Limes and Plaster," a standar work on these materials.

The Drummond Concrete Sepu chre Company has been incorporate at Philadelphia, with a capital stoc of $100,000. The incorporators ar W. J. Drummond, J. F. Simpson, J. Simpson, A. J. Golden, J. F Mickle, Philadelphia.

Edwin Edelman and F. Hirscl Winslow, Neb., will equip a concret block factory with the latest and bes machinery. Operations have com menced on the erection of a buildin which they will use for the purpose They have also secured a site on the Burlington right-of-way, on whicl they will erect sand sheds and i which they will store sand, whicl they will have shipped in from out side points.

WATERPROOFING CONCRETE WITH ASPHALT.

With the increased use of cement concrete for all kinds of building purposes has arisen the question of how best to make structures damp-proof and waterproof.

Methods which involve the mixing of waterproofing materials throughout the cement, while concrete is being made, and methods which involve the coating of surface of concrete with a non-elastic waterproofing material, prove inadequate and unsatisfactory, because when concrete settles or is jarred sufficiently it will crack, and at such places no longer be waterproof.

Methods which involve the coating of surface of concrete with an elastic waterproofing material also prove unsatisfactory because this coating can be too easily injured and removed by other objects coming in contact with it.

The method which practice has demonstrated gives the best satisfaction consists in applying the waterproofing materials between two sections or layers of the concrete structure.

The waterproofing materials should be not only impervious to moisture, but also unaffected by water and weather conditions; should be elastic so as to allow for settlement in the concrete structure, without breaking or cracking the waterproof stratum; should not dry out nor disintegrate on exposure to air, water, alkalies or acids.

Materials of this class when applied between two layers of concrete will give satisfaction, because they are waterproof and durable and allow for settlement of concrete and are protected against injury by the outer layer of concrete.

The accompanying illustrations are views of concrete reservoirs and settling basins built in various parts of the United States and waterproofed by a special brand of asphalt known as "Pioneer," which is manufactured by the American Asphaltum and Rubber Company, Women's Temple, Chicago.

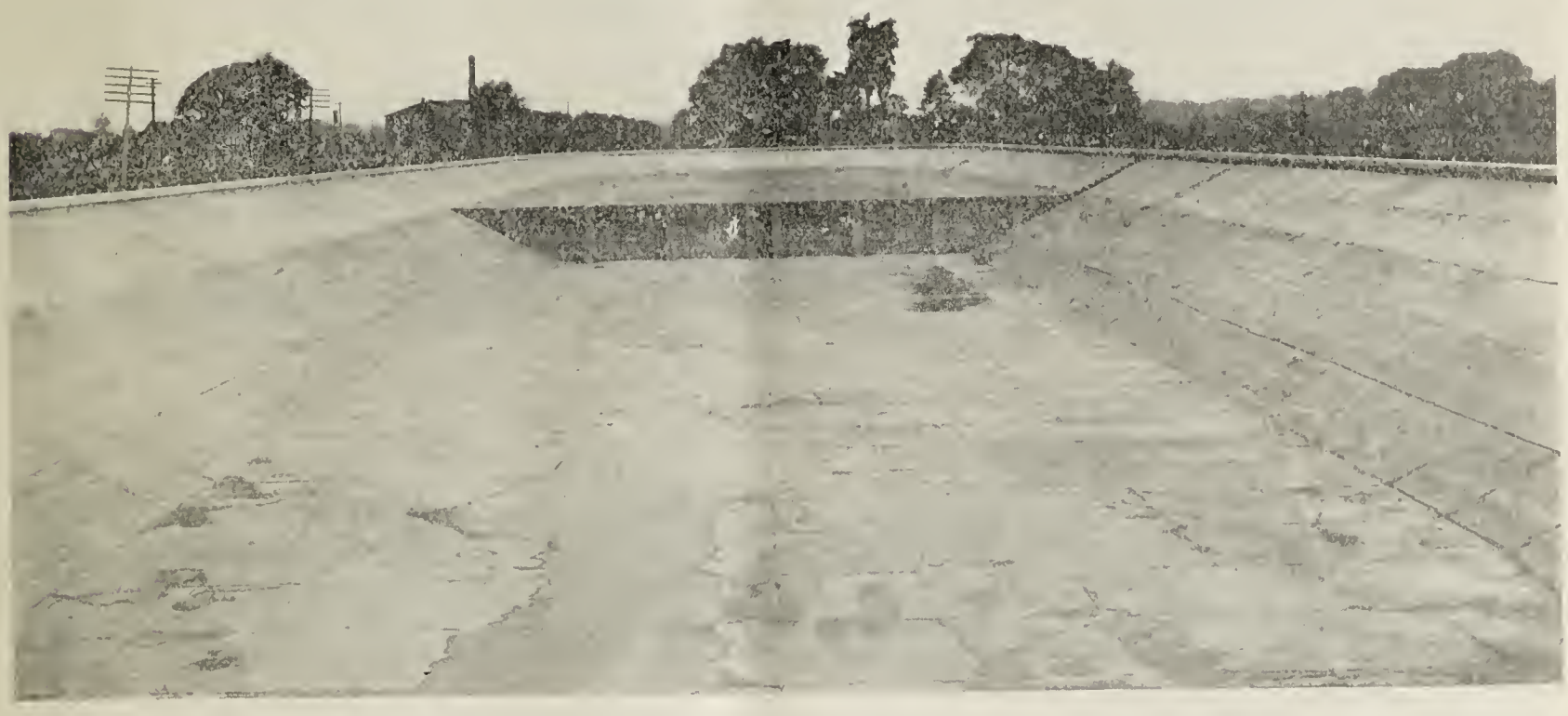
"Pioneer" Waterproofing Asphalt has proved by a successful record of twelve years that it meets all the requirements of a satisfactory waterproofing material. This material should be applied at about 425° F., with ordinary roofers' mops. Owing to the difficulty in making hot asphalt stick to a concrete surface, the concrete should first be given a coat of "Pioneer" Primer Paint, applied cold with brushes. This enters the pores of the concrete and tightly binds the asphalt to the concrete.

Where water pressure has to be contended with, the waterproofing stratum should be strengthened by the use of saturated felt put on in one, two or three thicknesses, as the case in hand may require, and each layer of felt mopped with hot asphalt.

The American Asphaltum & Rubber Company shall be glad to submit copies of their specifications for waterproofing reservoirs, bridge floors, subways, etc. Their specifications for reservoir waterproofing is as follows:

"After the first layer of concrete has become set and is perfectly dry, all dust must be carefully brushed off, and on this dry, clean surface, and also in joints between blocks, shall be applied, with ordinary paint brushes, one heavy coat of "Pioneer" Primer Paint, manufactured by the American Asphaltum & Rubber Co., of Chicago (or any paint equal thereto). Over each joint in concrete, there shall be placed a single layer of asphalt saturated wool felt, not less than eight inches in width, which felt shall be laid in hot "Pioneer" Reservoir Waterproofing Asphalt (or any asphalt equal thereto), which asphalt shall be heated to a temperature of between 425° F. and 450° F. On the primed surface and also over the strips of felt shall be mopped a heavy coating of the hot asphalt, which coating must be of uniform thickness of one-eighth of an inch.

"The above specification applies to side walls, bottom and ends of res-



A view of a concrete reservoir waterproofed with "Pioneer" asphalt.

ervoir. After the Waterproofing Asphalt has cooled the next layer of concrete is to be laid over it as provided herein. No asphalt need be applied in the joints of the second layer of concrete, as this layer is simply to protect the Waterproofing Asphalt."

The permanency of the structure depending as it does, upon the permanency of the waterproofing materials used, makes it necessary to employ only those materials which have been successfully used for this purpose for say at least a period of five years and contractors will be permitted to use only waterproofing materials of this class and record.

The reservoir and water works plant recently built at Muskogee, Oklahoma, with a 3,000 gallon capacity, is described by the city engineer as follows: "The original water works plant was built in 1904, when the population was about 5,000. In these three years the town has grown from 5,000 to a city of approximately 25,000, and this rapid increase of population has made improvements necessary each year since the original plant was completed. Like the cow that swam the river to get a drink, Muskogee found it necessary to cross the Arkansas River to obtain its water supply from the Grand River, which is a water of exceptional purity, except in rainy seasons when it carries large amounts of sediment. The pumping plant is located five miles from Muskogee, on the west bank of the Arkansas River, and two independent 16-inch and cast iron suction lines are laid under the bed of the Arkansas River and extending for a half mile up into the mouth of the Grand River, which discharges into the Arkansas River from the East. The two suction lines were laid on a temporary platform, built at low water, and when then gradually lowered into the water, a number of ball and socket joints being used to allow for uneven settlement of the pipe lines on the gravel bed of the river. Trenches were dredged and scooped out in the gravel to permit the pipes to settle to a slate bed beneath the gravel, which had an average depth of about six feet. Where the pipe lines cross the main channel of the Arkansas River, steel rods were driven into the slate bed on the down stream side of the pipes. These rods were then bent over the pipes, securely anchoring them in place. Low service steam driven pumps of two and one-half million gallons capacity, lift the water into two concrete lined settling basins, of three million gallons total capacity. The water is discharged into the West basin through an aerating device, then flows over a concrete weir into the East basin, thence into a circular brick coagulating chamber, where a coagulant of lime and sulphate of alumina is introduced into the water. It is estimated that about 80% of the sediment is deposited in the settling basins, which are arranged for convenient cleaning by wash pipes and waste pipes to the river. From the coagulating chamber the water flows to mechanical filters, arranged in one-half million gallon units, installed in a brick filter house. The filters are built of reinforced concrete, with mechanical stirring and cleaning devices, arranged for cleaning every twenty-four hours, or oftener if necessary. From the filters the water flows to a concrete lined reservoir for pure filtered water. This reservoir is roofed to exclude dust, leaves and other dirt. Water flows by gravity to the high service pump, which is a vertical duplex compound condensing engine. This pump delivers the water to a standpipe of a half million gallons capacity, against a head of 300 feet. The standpipe is 120 feet high and 25 feet in diameter, built on a masonry foundation extending to solid rock.

The power plant consists of three 100 horse power return tubular boilers, arranged in a battery with mechanical shaking and dumping grates. Coal is delivered to the plant in cars operated by the Interurban Electric car line, although natural gas or oil will probably be used as fuel in the near future, as there are now many producing wells within a few miles.

Expansion joints in the concrete lining of the settling basins were used to prevent cracking from settlement,

Showing method of building reservoir. "Pioneeer" asphalt used in joints of concrete blocks for waterproofing.

or contraction and expansion of the concrete.

The joints were filled with a liquid asphalt mixture prepared especially for the work by the American Asphaltum & Rubber Co. of Chicago.

Reservoir during construction.

The entire plant was designed and supervised by Burns & McDonnell, Consulting Engineers of Kansas City, Mo., who have the following to say concerning the asphalt waterproofing of the settling basins.

"We are pleased to say the expansion joints filled with the material furnished by American Asphalt & Rubber Co., are holding very satisfactorily. These basins were constructed on sandy soil and foundations, where if leaks occurred, the water would soon run out through the sand. Up to the time we used this material we had poor success in finding satisfactory material for use in expansion joints, but now, after giving this material a thorough trial, we find it gives excellent satisfaction, and, in all our present and future work, we are not hesitating to specify "Pioneer" Reservoir waterproofing asphalt for expansion joints and waterproofing. We are also using the material on the new waterworks plant at Oklahoma City, Okla."

Messrs. Burns & McDonnell made a very thorough investigation before deciding to employ it for this particular construction, and wrote:

"Our firm contemplate the adoption of a specification which will forbid the use of inferior grades of asphalt for this class of work."

and later on, specified it as follows for this construction:

"The concrete on side slopes shall be laid in strips ten feet in width, extending from the bottom to the top, each strip being separated from the ones adjacent thereto, by a steel separator ¼-inch in thickness. As soon as the concrete shall have become sufficiently hard, the separator shall be withdrawn and the space filled with suitable asphalt preparation, which shall be genuine Asphalt Filler, known as 'Pioneer Asphalt,' produced by the American Asphaltum & Rubber Co., of Chicago, Ill.; the asphalt shall be not less than 99.5% pure bitumen, composed of not less than 68.3% petrolene and 31.2% asphaltene (each having a specific gravity of about 0.90 and 1.13 respectively." The specific gravity of the compound shall be about .99; shall not be tacky at a temperature of 125° F. after an exposure of 5 hours at this temperature; the melting point shall be not less than 210° F., or by capillary tube tests it shall not commence to melt below 195° F. nor run below 215° F.; the compound to weigh not more than 7½ to 8 pounds to the gallon, or not less than 250 gallons to the ton; it shall remain ductile at all temperatures shall be an absolute waterproofing; it shall firmly adhere to the concrete and yet be pliable rather than rigid, thus providing for expansion and contraction."

COST OF CONCRETE BRIDGES.

Concrete—either plain or reinforced —as a material of bridge construction possesses the merits of being adaptable as a substitute, within limits, for both stone masonry and steel framework, and of combining the qualities of both. It is equal to and may be more economical than stone masonry for abutments, piers, retaining walls, coping and parapets, and in many cases makes an arch available with its manifold advantages where a stone or brick arch would be impracticable.

It is found also to be an advantageous substitute in the shape of jack arches or reinforced slabs for steel floor troughs and buckled floor plates on steel bridges, whereby we have a composite structure—not strictly reinforced concrete, but a combination of steel members and concrete members. The resulting product, when the design and workmanship are

good, is a rigid, enduring and economical bridge.

The limitation of the proper and economical employment of concrete in bridge structures can hardly be stated, certainly not with any degree of definiteness. Conservative designers are not in entire accord with respect to either methods of use or allowable working stresses, and comparisons of value and cost between all steel and part of all concrete or reinforced concrete can only be made on finished designs and for the same site. Even then estimators may not agree as to which will cost the most, and, if we may judge by the wide range of prices quoted in contractors' proposals, the contractors themselves cannot more accurately determine relative values in cost. To the beginner or purchaser the cost of a bridge is the contract price—the cost to the builder should, of course, be less.

The actual cost of a job to the builder is usually not published and is rarely divulged to even the engineer, and an engineer's basis of estimate must be the bids and contract prices previously obtained. Any list of costs will exhibit great variation in the figures for structures of the same class and similar dimensions and conditions, and when the most infinite variety of conditions and combinations of varieties are considered, the difficulty of conveying useful intelligence on the subject is apparent.

The length of span, width, height, depth and character of foundations, length and shape of wings, loads to be carried, amount of filling or grading, railing or parapet, character and amount of paving, plain or decorative architecture, character of the concrete—plain or reinforced or rubble, market price of materials, and accessibility of the work to railroad service, all effect the question of cost.

It is therefore impracticable to select any unit of measure of a bridge and use it as a reliable basis for estimating cost. In a table covering 18 concrete arch bridges recently built in Philadelphia the concrete price spread upon the span area—the clear span by the width—varies from $3.11 to $9.74 per sq. ft., and it varies from $1.73 to $7.39 per sq. ft. of area occupied by the ground plan to ends of wings, the latter extremes being not on the same bridges as the other two. The average of the lot was $6.25 per sq. ft. of span area and $3.50 per sq. ft. over all, most of them being single span bridges with long wings, and all being highway bridges designed to carry loads of 40 tons on two axles 20 ft. apart. All have ornamental concrete balustrades and washed granolithic surfaces and paved decks, with electrical conduits and manholes, and water pipe and sewer well-holes, and some have pretty deep foundations.

If the whole contract price be set against the yardage of the concrete in the structure the unit costs vary from $8.50 to $11.25 per cu. yd., averaging $9.75.

It is found that in the circumstances under which the bridges referred to were built, steel plate girder bridges will cost more than concrete arches, the difference being considerable. Several opportunities for fair comparison have made this clear, as great a difference as 25 per cent of the higher being indicated. This saving is in the first cost, and if we add the capitalized cost of proper maintenance of the steel structure—which seems to be a fair element in the comparison—the advantage of the concrete arch appears far greater. A real money value also attaches to the superior beauty and attractiveness of a decorative arch structure in almost any locality—a question that almost always is the subject of consideration and decision in designing public work, for it must be determined what amount is proper to be expended for mere appearance.

The composite bridges—steel structural frame with concrete envelope—share with the arches—or at least promise to—the quality of permanence, and therefore exemption from expensive maintenace charges. As between the ordinary steel plate girder bridge with buckled plate floor for permanent paving, and the composite type, the lower first cost is with the composite if the spans be short, for the greater dead weight of the concrete floor tells on the long main girders whose section is usually determined by the general load, dead plus distributed live—while the individual floor members are determined by the heavy concentrated live load. The embedment of the floor stringers or joists in the concrete pack-arch construction effects a saving of steel, first by dispensing with floor plates, and second by permitting lighter stringers to be used, for the jack arches distribute a concentrated load over say three beams, where a buckled plate floor each beam must carry the whole concentration, and besides, the embedment of a beam in concrete increases its carrying capacity about one-third.

Where it is the practice to protect steel bridges over railroad locomotive service by means of a wooden ceiling under the whole underside of the bridge, the economy of the concrete floor is more marked because such a ceiling costs about 25 cents per sq. ft. and lasts only a few years. This first cost alone will pay for about 1 cu ft. of concrete in the floor, and only about 15 to 18 in. average thickness of floor concrete is required. As steel floor plates with their riveting cost from 50 to 75 cents per sq. ft., the concrete floor appears to cost only about one-half as much as an all steel floor, besides saving materially in the stringers. Floor beams may or may not be required to be heavier to carry the concrete floor. If they are not very long, the value of the concrete embedment may make up for the increased dead load stress. The main girders will need to be heavier than for the steel floor because little or no value can safely be assumed to be derived from the concrete casing.

The cost of concrete bridge work of almost all classes can be materially reduced and the service value of the concrete at the same time increased by the embedment in the concrete of suitable hard stone in size from that of spalls to the largest that can be conveniently handled or that will be comfortably accommodated in the compass of the forms. The economy of this construction depends upon the cost and shape of the embedded stone and the amount embedded without too much labor expended and without restricting the output of the concrete plant. It has been found that the percentage of the volume of the finished work that such stone amounts to varies from 25 to 40, or from 33 to 66 per cent of the volume of the mixed concrete, according to the shape of the stone and the care taken in placing it.

The cost of handling and placing this approximate third is probably about equal to that of mixing and handling and placing an equal volume of concrete. The saving therefore should be the difference between the delivered cost of the concrete materials and that of the stone. If the stone delivered costs one-half as much as the cement and sand and gravel that when mixed equals it in volume, and if the embedded stone amounts to only one-third of the finished work, then the cost per cu. yd. of the finished work is 80 per cent of that of plain concrete.—(Henry H. Quimby, Engineer of Bridges, Philadelphia.)

W. H. Ham, M. Am. Soc. C. E., has resigned as Chief Engineer of The General Fireproofing Company to take up the Department of Concrete Engineering with the firm of Messrs. Hollis French and Allen Hubbard, Consulting Engineers, Albany Building, Boston, Mass., specialists in hydraulic and power development work heating, ventilating, electrical engineering and concrete structural design.

ECONOMIC HEATING.

Probably no field of human endeavor has been given closer study, or passed through more experiment, than that of heating. Like every other problem having to do with the betterment of living conditions there have been many fads and failures while successes have been few.

The road from the open fireplace of "ye olden days" to the modern method of heating the home, covers generations of experiment and embraces the expenditure of countless millions of dollars in arriving at the present perfected methods of warm air heating.

For either the farm or city home, time has demonstrated that warm air —not superheated air—is the best, and in fact, the only safe and sane system embracing all three necessary essentials, viz.: health, comfort and economy. In this connection the wonderful record, established during the past twenty years, by what is known as the Hess Method of Warm Air Heating, is worthy of close investigation by readers of The Cement & Engineering News.

Herewith is published a sectional view of the installation of a "Leader" Hess Steel Furnace, as planned to heat a seven or eight-room house, showing position of furnace with fresh air and return air supply; floor and special sidewall registers below partition stack and water register above. On another page will be found an advertisement setting forth the remarkable offer which the Hess Warming and Ventilating Company is making in connection with the sale of their furnaces and furnace supplies.

That the Hess Furnace is one that proves satisfactory in every way is testified to by a little booklet bearing the title, "These Bear Witness." This booklet contains genuine testimonials from every state in the union, together with names and addresses of hundreds of satisfied purchasers of the Hess furnace. Here are two of the testimonials taken from the booklet:

"Las Animas, Col., May 25, 1908.
"Hess Warming and Ventilating Company,

"I want to say a few words in regard to the merits of your furnace which we are using in our ten-room house. We are more than satisfied with it as a fuel saver and heat producer, and, comparing our coal bill with that of our neighbors who are using other systems of heating, we saved last winter at least 50 per cent on fuel. My wife and myself installed our furnace in three evenings, though we had no experience in that line at all.

"We can truthfully recommend the Hess furnace.

Very respectfully,
F. J. Beck."

"Washington, D. C., May 9, 1908.
"Hess Warming & Ventilating Company.

"The No. 50 Hess Furnace, purchased from you last fall, gave satisfaction during the winter, warming my entire house of seven rooms with six tons of hard coal. Your method of selling was of great advantage to me and you seem to be square dealing people. I bought your furnace after investigating several hot water propositions, and I am satisfied I made no mistake, as a neighbor put in a $600 hot water plant at the same same time and he told me it took two tons of coal a month and did not make his house very warm at that. If I was going to buy another furnace it would be a Hess.

Respectfully,
"J. M. Bolton."

In connection with the testimonials appearing in the booklet, which is sent free upon request, is the following offer made by the company:

"A Furnace Free.—Will be given to any one who will show that any fictitious names or testimonials are contained herein, or that any testimonial has been paid for or obtained by any but fair means.

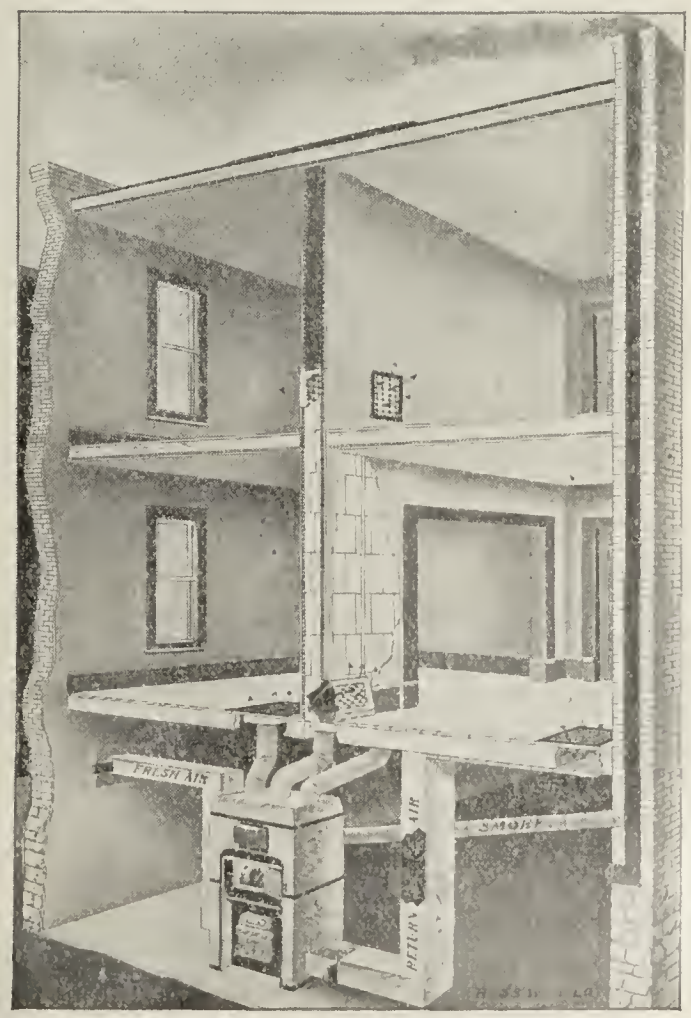
"Investigate as far as you choose and you will learn that we know the heating business from A to Z, and that we will give you a "square deal" and will make money for you.

"You can learn of our responsibility by consulting any wholesale house in Chicago, Bradstreet's or Dun's agencies, or the Corn Exchange National Bank, Bankers, Chicago.

"Hess Warming & Ventilating Co."

Being manufacturers, they sell direct at factory prices and offer free trial till Jan. 1st 1910, and no pay till the goods have proven satisfactory. They "have to make good," and no one runs any risk in accepting their proposition. By furnishing them with a rough sketch of any building to be heated they will send, free, a special plan, which can be easily understood, showing exactly how to heat your building to the best advantage. This does not obligate you to buy of them.

Another special feature of their special selling plan is their great cooperative offer whereby every person buying their furnace can get his or her money back from additional sales that may be made without doing any canvassing or soliciting. The Hess Warming and Ventilating Company, 919 Tacoma building, Chicago, is a reliable, long established house, thoroughly responsible, and the Cement & Engineering News can recommend them as being a company that will live up to the spirit and letter of every promise made. Write for their booklets and special offer.



Everything for Furnace Work

On Free Trial Until Jan. 1st 1910
At Our Expense

OUR story is quickly told. We will send you a **Hess Steel Furnace** and complete heating outfit, including pipes, registers, fittings and everything needed, for from $25 to $100 less than you can buy from dealers. You may place the purchase price in the hands of your local banker who will hold the money until January 1st, 1910, while you test the heater.

If the test is not satisfactory to you in every way, you may return the goods at our expense and have your money back, we to pay the cost of removal and freight charges both ways. Ask us more about it. There's money in it for you. Our great co-operative plan makes you a partner in our success. We explain this with every estimate. This offer also applies to heating equipments for all buildings. **We manufacture and sell from our factory direct to you and loan you the tools free with which to install the outfit.**

Our No. 45 "Leader" Steel Furnace Heats 7 or 8 Rooms

Price $49.00
Delivered to any Station East of Omaha & North of the Ohio River
Pipes and Registers Extra

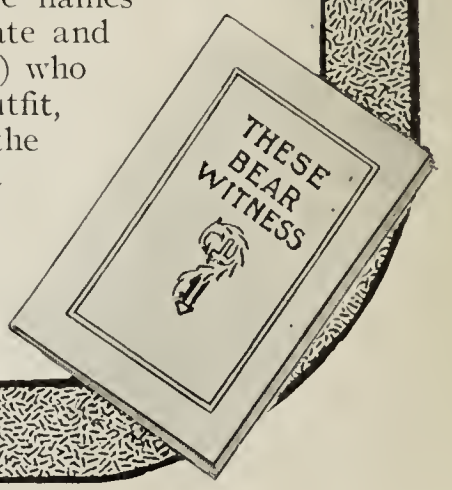
Special Heating Plans Free

Send us a rough sketch of any building you wish to heat and, without any charge or obligation on your part, we will have our experts prepare a simple, clear plan which you can easily understand, showing every detail of the furnace, pipes, registers, etc., in their proper places, with the exact cost to you of the complete equipment.

Write For These Booklets

Our booklet **"Modern Furnace Heating"** clearly explains principles that cannot be ignored if the heating of any building is to be accomplished perfectly and, at the same time economically. This booklet is written so anyone can easily understand the diagram illustrations and principles involved. It covers the entire heating proposition thoroughly and contains heating information of much value.

The booklet **"These Bear Witness"** gives the names and addresses of hundreds of people in every state and territory (many of them, perhaps, your neighbors) who have, and are using, the Hess Steel Furnace and outfit, and to whom we refer as having found our furnace the best in heating capacity and most inexpensive in first cost and fuel consumption.



THESE BOOKLETS ARE FREE.
WRITE FOR THEM TODAY.

Hess Warming & Ventilating Co.
919 Tacoma Bldg. Chicago

CEMENT
.....AND.....
ENGINEERING NEWS

New Concrete Bridge at Waterloo, Iowa.

7,805 Barrells of "A A" Cement Used in Its Construction Furnished by

Chicago Portland Cement Co.

See Page 148.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

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CHICAGO, MAY, 1909.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experiments will be welcome.

GOOD AND BAD CONCRETE WORK

Good material does not always produce good concrete work. Much depends upon its intelligent use; proper proportioning of materials, and care after the work is in. Skimping of cement, that is, using too little in order to cheapen the work, is one of the grave and serious faults of the contractor who will take work at a low figure, and be compelled to skimp on the materials to prevent loss. Such men are an injury to the concrete industry, bringing it into disrepute. The contractor who demands a fair price which will enable him to produce good work, rather than employ the cheap unreliable contractor. We have known of concrete work, where the reliable contractor has been offered $10,000 above the lowest bidder, and even this was refused because it was $5,000 less than the estimated price for good work on this particular job. The job was finally given to the contractor with a reputation, for $15,000 above the lowest bidder. This shows the value of a good reputation in concrete work. Our large cities have a set of bidders on all kinds of concrete construction work, consisting of contractors who have no local reputation. They simply have offices in their hats. These contractors offer, and actually give written guarantees on their work. If you find the work defective, and wish to enforce the guarantee, you will find that the contractor has flown to parts unknown. After an owner has been bitten a few times, he begins to find out that it pays to deal with reliable and trustworthy men, who can be located and called to account. It will be found true from experience, that the cheap contractor, especially in concrete work, is a dangerous man to deal with. Better pay too much for your work than too little in the beginning, it will prove cheaper in the end. The man who takes work at too low a price, intends to cheat the material man, or the party for whom the work is done. Our advice is to avoid the cheap contractor if you want good work.

THE IOWA PORTLAND CEMENT CO.

Great preparations are being made for the opening of the Iowa Portland Cement Co. on June 1st. Mayor Mathis is to work the starting lever to set the plant in motion. The entire community are invited to be present at the opening. All comers are to be entertained. A large 65-room hotel has been finished, together with numerous cottages to house employes, surrounding the plant. A branch street car line will be built to the plant.

A long reinforced concrete bridge at Peoria, Ill., spanning the Illinois river collapsed on April 30th, due to the severe storm on the 28th and 29th of April. One span gave way after the foundation was undermined by the two days' storm. After sagging for two days, it collapsed. The Marsh Bridge Co. were the contractors, at $250,000. The Marsh Co. are bankrupt.

The Sandusky Portland Cement Co., which now operates a private industrial railroad from its plant at Syracuse, Ind., to one of its main deposits near Milford, Ind., is considering the extension of its line to Milford, provided it can purchase the right of way for the extension at fair valuations. A depot will be built at Milford, and the road from Syracuse to Milford to be opened for public service.

WOLVERINE REPORT.

The seventh annual report of the Wolverine Portland Cement Company, of Coldwater, Mich., is out. The sales of cement and packages from March 1, 1908, to January 31, 1909, amounted to $546,255.16. There was collected up to February 28, 1909, $539,276.95. At this date there is uncollected the small sum of $2,482.28. The assets of the company are $1,185,801.79.

NEW CONCRETE BRIDGE AT WATERLOO.

The bridge illustrated on the frontispiece of this issue, is one of the finest examples of reinforced concrete construction in the country. It is at Waterloo, Iowa, and was designed by City Engineer C. T. Wilson. The contractors were Bartlett and Klinger of Cedar Rapids. The bridge consists of eight spans, each 76 feet in the clear; 7 piers, each 8 feet through at the level of the spring line; abutments 26 feet across and 11 feet of retaining walls at each side of the roadway, continuing from one abutment to the old shore line. The space between the retaining walls was filled in the same as the space between the spandrel walls. These figures make a total length of the bridge over all of 826 feet. The foundations of the retaining walls are 5 feet below low water. The width of the bridge is 58 feet from face to face of the spandrel walls, while at the pier foundations it is 68 feet. The retaining walls are of the gravity type. The arches have a rise of 16 feet 6 inches above the spring line with a thickness of 16½ inches of concrete at the crown. The reinforcement consists of 1 inch square deformed rods placed 16½ inches on centers and 2 inches in from the extrados of the arch; also ¾-inch square deformed bars place 8¼ inches on centers and 2 inches in from the intrados of the arch. These bars were laced diagonally with tie rods of ⅜ inch round steel. The arches were reinforced with bars running transversely, both at the extrados and the intrados, and placed 5 inches on centers. The longitudinal, reinforcing steel was in but one length from one pier to the next, and the ends of all extradosal bars were hooked together over the center line of the piers.

The work was awarded to the contractors February 18, 1898, and was completed well within one year, even after much delay during the forepart of the construction on account of high water and also on account of unlooked for conditions which were found when excavations were made for the foundation, necessitating piling and extra work at places where previously it was not contemplated.

Previous to the construction of this bridge another had to be removed, the old one being of iron. For the use of the illustration of this bridge we are indebted to the Chicago Portland Cement Company, 7,805 barrels of whose "AA" cement was used in its construction.

FIRE LOSS VS. FIRE CONSTRUCTION.

I know of no better exemplification the old adage that "haste makes aste" than the enormous loss in this untry caused by the inferior conuction of our buildings. In our ad rush we have evidently been oking only to the present, and we ve given very little consideration the future. Our construction has en largely temporary when safety d economy would suggest that we ve the greater consideration to peranency. The annual fire expense, cluding the cost of fire protection, s reached in some years the enorous sum of $600,000,000 with a ath loss of 7,000 persons. This presents a tax of $6.00 per capita, t including the loss of profits to the siness man who has been burned it for the time he is out of busiss. In dollars it exceeds the value all the crops raised on the farms Minnesota and Iowa last year, and a loss greater in value than the tire 1908 wheat crop of the United ates. It equals in value yearly the tire consumption of coal in our naon for all purposes. If you were to ad cars enough with corn to fill ery mile of railroad in Iowa, cluding all side tracks and spurs, d then burn it up, cars and all, it ould not equal our normal fire exnse. The annual fire loss in our untry averages $2.30 per capita, hile that of all the European counies combined is but 33c. In the reign countries there is an average less than one fire per year to every 000 population, while here we have ½ fires per 1,000.

Natural conditions are conspiring bring about a change, and the inreasing cost of combustible building aterials has caused us to look for mething else, and, fortunately, at e same time, public attention has en called to the great waste by fire. nd, therefore, efforts have been ade to introduce and use fire resting building materials. To us is ntrusted, very largely, the work of lieving our country from this usess burden. It is doubtless true that eretofore we have given too little ought to anything but the original st of construction, but as we see the eat waste resulting from our oughtlessness, and, above all, when e have brought home to us the normous loss of life and begin to alize that all over our country we re endangering the lives of those ost near and dear to us we are roused. An active movement has een started to secure fireproof conruction, especially in our public uildings. While this movement has een under way but a comparatively few years considerable progress has been made, and today there is scarcely a city of any size where there is not a strong sentiment in favor of fireproof construction for all public and semi-public buildings. Yet how little has been accomplished is shown from the fact that with some 12,000,000 buildings in this country, there are only 8,000 which are even so-called fireproof, while, in all probability, 2,000 will cover the number which are actually fireproof. While, naturally, the largest proportion of our fires cause the destruction of residences yet there is an average weekly burning of 3 theatres, 3 public halls, 12 churches, 2 hospitals, 2 asylums, 2 colleges, 26 hotels, 3 department stores, 6 apartment houses, 2 jails and 1600 dwellings. We have but to refer to any of our daily papers to verify these statements. Within the last week I have noticed the following:

In Chicago, the complete destruction of the plant of the Kinley Manufacturing Co., with a loss of $235,000, endangering the lives of 200 men and 30 women;

The destruction of the McDowell Hall, St. John's College, Annapolis, Maryland;

A loss of $300,000 at Columbus, Ohio, in the burning of the buildings of the Brunswick Bowling Co. and Tracy Wells Company;

In St. Louis a loss of $100,000 in the fire of the Mulvihill Furniture Co.;

The complete destruction in Chicago of the warehouse of the Albert Dickenson Seed Co., entailing a loss of $200,000 and serious injury to five firemen;

In Milwaukee, fires entailing a loss of $100,000 with a loss of life of five people;

In Louisiana, the burning of a sugar warehouse with a loss of $200,000.

In Buffalo, a fire which caused a loss of $300,000. $150,000 fire destroying the butterine plant of Swift & Company, Chicago.

The loss of life in such fires as the Iroquois and Boyerton theatres, and the Collinswood public school, has touched the hearts of our people, while the great conflagrations like Baltimore, San Francisco and Chelsea have touched our purses, and the two influences have given a great impetus to a movement for safer and more permanent construction.

The press, usually alert and active in all our great reforms, has taken up the cause, and is doing effective work, daily calling the attention of the public to the necessity for better construction, even going into details and furnishing information as to materials and general plans suitable for fireproof buildings. This agitation has accelerated the manufacture of building materials that are best calculated to form the greatest resistant to fire, increasing the demand for larger factories, improved methods and machinery, with a corresponding reduction in the manufacturing cost. This is most noticeable in the case of Portland cement and cement products, and more particularly in the rapid development of cement block, brick and reinforced concrete. All of these influences working together have made it possible now to construct an office, warehouse or business building which is practically fireproof at as low a cost as the construction in general use. There is no longer any excuse for building tinder boxes which are a menace to the safety of life and property. Most people have an idea that the cost of fireproof construction is so great as to prohibit its use in residences, but it is possible now, where experienced mechanics are obtainable, with the various fireproof materials at hand, to construct a non-inflammable residence at as low a cost as with lumber, and I predict a general adoption of such construction in the entire country. At present there is a distinct national movement having for its object the conservation of our forests, and it has been started none too soon. From reliable data covering the annual lumber consumption and the present supply, after making liberal allowance for the growth of young timber, we learn that if the rate of increased consumption per capita which has obtained during the last ten years should continue our supply of timber would be entirely exhausted in less than twenty years. Undoubtedly the full realization of this condition is stimulating our efforts to utilize other building materials, and necessity is thus forcing a reformation which reason ought to have produced years ago. We have reached a point where something more substantial and definite than public agitation should be secured.

There should be a law in every state defining fireproof buildings, and providing that all public and semi-public buildings should be of such construction. Our statutes are filled with laws enacted for the purpose of protecting property and life. We provide safety appliances in transportation and impose penalties to secure the enforcement of these laws; and we even go to the extent of prescribing our meat and drink. Nearly all of our states provide for fire-escapes on hotels and all buildings where a large number of people are gathered. But this is only a medicine intended

to relieve the disease, while we ought to go to the root of the matter and remove the cause, thus providing a complete preventive. It is criminal carelessness for us to confine our children in school buildings, the interiors of which are so constructed as to invite fire, panic and disaster. We penalize the careless employer and by law enforce him to compensate the injured employee, while we, the public, are endangering the lives of hundreds of thousands by our negligence. The exteriors of most of our public buildings are of brick and stone, and by rebuilding the interiors can be made substantially safe. Brooklyn, with its staid, old German population, has taken the initiative by deciding a year ago that all school buildings must be fireproof. They have been remodeling all old buildings by replacing the wooden construction with reinforced concrete floors and ceilings and fireproof partitions. The cost of rearranging the interiors of our school buildings would place no perceptible burden upon any community—all of which would be saved in a few years in insurance and repairs.

Gradually we should escape from this heavy fire tax, and within the next quarter of century our statistics should show the lowest annual fire loss of any country in the world. The movement has been started, it has the support of some of the most influential and prominent men in the country, and I believe that we may confidently look forward to a time in the near future when the condition will be completely reversed, and we will escape the onus of the great loss of life and property which is now so apparent. With the double incentive of increased business and profits, and the comfort and protection of the lives of our people, we should all become boosters in this great movement.—(Paper by J. C. Burch, Sec'y, Iowa Port. Cement Co. Read at annual meeting of the Northwestern Cement Products Assn.)

A number of the Lehigh Portland cement plants were resumed on May 2nd, including the Whitehall, Mill F of the Lehigh Portland Cement Co. at Ormrod, and Mill 3 of the Atlas Company.

Harry E. Mick, late chemist of the Western Portland Cement Co. plant at Yankton, S. Dakota, has accepted the position of chemist with the German-American Portland Cement Co. at La Salle, Ill. Mr. Mick expects to take a position with the projected Portland cement plant at Chamberlain, S. Dakota, as soon as that project has matured.

DIVIDENDS OF GERMAN CEMENT PLANTS IN 1908.

Adler Portland Cement Co.	10
Alsen Portland Cement Co.	9
Breitenburger Portland Cement Co.	8
Germania Portland Cement Co.	8
Giesel Portland Cement Co.	9
Hemmoor Portland Cement Co.	10
Hoxter-Godelh Portland Cement Co.	0
Lothr Portland Cement Co.	9
Oberschlesische Portland Cement Co.	6
Oppelner Portland Cement Co.	10
Rhein-Westfal Combine Portland Cement Co.	16
Sachs Thurwig Portland Cement Co.	12
Saxonia Portland Cement Co.	11
Schimischower Portland Cement Co.	9
Schlesische Portland Cement Co.	10
Schwanebeck Portland Cement Co.	12½
Stettin Bredower Portland Cement Co.	7
Teutonia Misburger Portland Cement Co.	20
Vorwohler Portland Cement Co.	22
Westfalia Portland Cement Co.	20
Wickingsche Portland Cement Co.	12
Heidelberg Portland Cement Co.	12
Karlstadt Portland Cement Co.	12
Halle Portland Cement Co	5
Bremer Portland Cement Co.	8
Oberschl Portland Cement Co.	9
Grundmann Portland Cement Co.	14
Gogolin-Gorasdzer Portland Cement Co.	13
Gossnitz Portland Cement Co.	8
Hannoversche Portland Cement Co.	4
Heyn Gebr Portland Cement Co.	4
Bayer Portland Cement Co.	12
Alsensche Portland Cement Co..	
Breitenburger Portland Cement Co.	8
Hungaria.	
Beocsiner Union Portland Cement Co.	32
Austria.	
Associated Portland Cement Mfgrs.	56
Konigshofer Portland Cement Co.	64

The White Cliffs Portland Cement Co. was sold at Master's sale of the U. S. District Court at auction. Only two bids were received, the highest being $28,000, made by Charles Campbell, who was the purchaser. The plant was held at an upset price of $68,000, under judicial sale. It was offered at this price during the past nine months, the date of sale being adjourned from time to time by the receiver on account of want of bidders.

ENAMEL CONCRETE MACHINERY PROJECTS.

The Enamel Concrete Compan of Des Moines, Iowa, has made a offer to the Greater Des Moine Committee providing that the com pany will remain at Des Moines, o $50,000 in subscriptions for its pre ferred stock. The company claim that other cities are willing to tak $100,000 of its preferred stock an furnish free sites for a large plan to have the company locate in suc outside cities.

The company likewise claims t have a deal on with German capital ists whereby the Enamel Concret Concrete Co. is to dispose of its Ger man rights for one million dollars the parent company to retain a por tion of the stock in the German com pany. The German promoters ar requesting samples of the company' product and blue prints of the ma chinery, and a representative is to b sent to Germany at once. We know of similar propositions for American machinery coming from German cap italists that never matured, one be ing the Simpson Brick Press of Chi cago. Mr. Simpson found there wa many a slip between the cup and th lip.

The Ogden Portland Cement Co was incorporated at Ogden, Utah on May 1st. Capital stock $5,000 The officers of the company are Willard J. Dell, Newago, Mich president; Harold C. Day, Chicago vice-president; Ralph E. Bristol Chicago, secretary and treasurer. Th board of directors included the abov named officers, together with Alvi T. Short of Grand Rapids, Mich and Henry E. Baker of Ogden Utah. The company announces i will manufacture cement and by products, with offices at Ogden Utah.

TUFA CEMENT.

The City of Los Angeles recently advertised for bids for crushing ma chinery for crushing Tufa, a con glomerate volcanic rock which i found near the site of the city o Los Angeles' municipal aqueduc cement plant. No bids for the ma chinery being received, the Board o Public Works now ask for authority to purchase this machinery direc without advertising for the same, un der an emergency clause of the char ter, the cost not to exceed $7,500 The time consumed to re-advertis would be too long and delay the progress of the work. This Tufa cement is to be used in the construc tion of the municipal cement plant where natural cement will answer.

ALCIUM ALUMINATES; THEIR EFFECT ON MORTARS.

By Henry S. Spackman

The effect of the addition of separately prepared cal-um aluminate to the ordinary mortars used in the uilding trade has been carefully studied by the writer in ıe course of an extensive investigation covering the ynthetic production of Portland or similar cements; that , the method of making such cements by mechanically ıcorporating the ingredients without combining all the rgillaceous and calcareous elements by calcination. This ıvestigation grew out of striking results obtained some ears ago in investigating the amount of material in ortland cement actually active in producing the harden-ıg of the mortar.

When once undertaken, the scope of this investigation ıto the production of cement by synthetic methods roadened and became so involved that it has, up to the resent time, included a vast amount of work, extending ack over a number of years. For instance; the reac-ons of the single cement elements, such as lime and lica were studied under various physical and chemical onditions, and a large number of two-element com-ounds investigated, such as the calcium silicate and alcium aluminate series. Many striking incidental re-ılts were obtained by these are overshadowd by the ıdustrial and theoretical importance of the demonstra-on by this work of the practicability of producing re-able cements by the incorporation of only a small per-ntage of accelerating of energizing material with ıixtures of ordinary lime and shale, clay or other silic-ous material in finely divided condition.

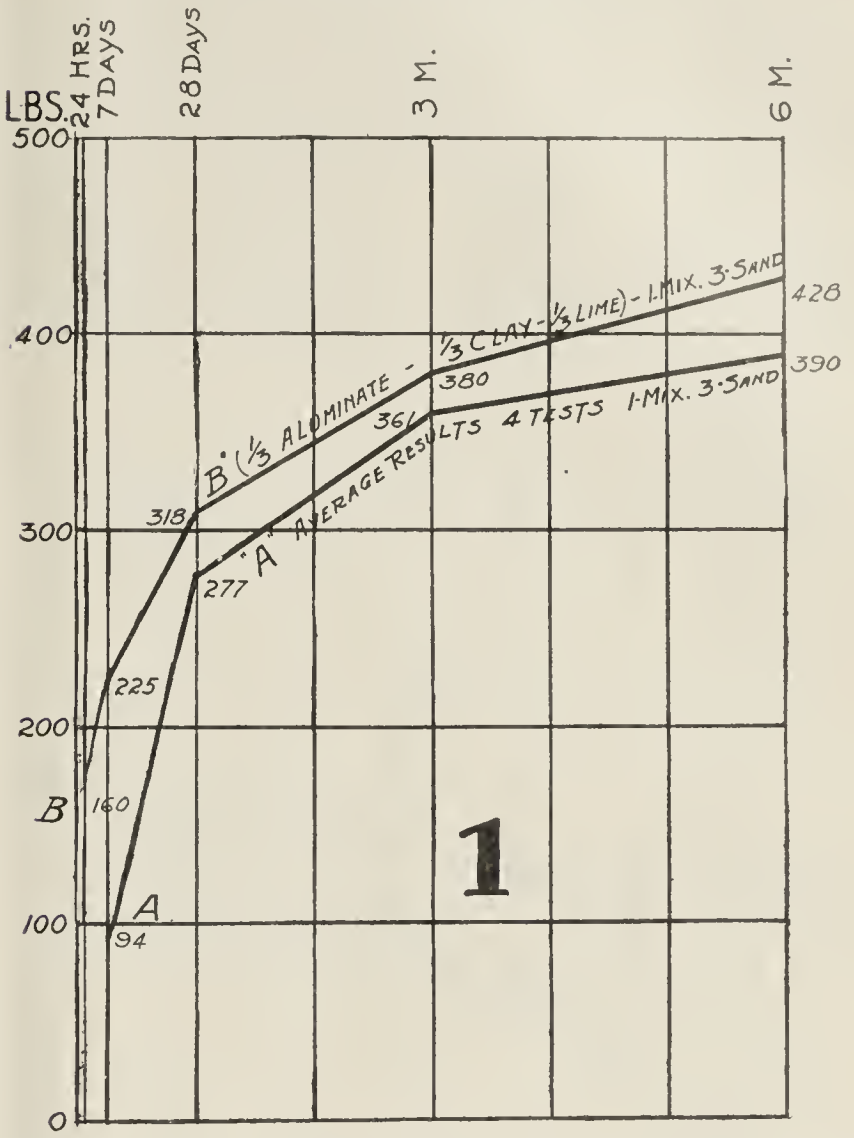
We noted the effect of the addition of small quanti-es of calcium aluminate accelerator to mixtures of vari-us proportions of hydrated lime and finely ground sand nd of lime and ordinary field clay or shale which were sed in their natural condition in which they possessed o hydraulic or cementitious qualities. Not only were ıe clay and shale alone devoid of binding properties, ut mixtures of these with lime gave no hydraulic qual-ies and only insignificant strengths, but with the addi-on of calcium aluminate decided hydraulic and cemen-tious qualities were developed in these previously prac-cally inert mixtures. Practically any setting time de-ired could be secured by proportioning the amount of ıe accelerator and of retarding material, such as cal-ium sulphate, and so forth. The strength of mortar ıade with such mixtures can also be increased consider-bly above Portland cement strengths at earlier periods y using more of the accelerator.

The experiments show that very valuable results were ecured by using the accelerator with hydrated lime lone; the addition of small proportions of calcium luminate to hydrated lime gave valuable wall-plaster ompositions having quick hardening and increased preading properties and very considerable strength in ir at short periods, while larger proportions of acceler-tor gave strongly hydraulic compositions of greater trength. Incorporation of the accelerating material with ass-lime compositions gave striking results and natural ements are greatly improved in their early strengths, ardness, and resistance to abrasion by the use of a mall percentage of the aluminate.

The aluminate compositions used in the investigation aried from those having approximately one-half mole-ule of lime to one molecule of the acid elements to mixt-res having three molecules of life to one molecule of he acid elements.

Tests were also made with aluminates prepared from auxite and other materials, such as kaolin, high alumina lags, etc., all of which were found to work in a satis-factory manner, the presence of considerable amounts of iron and silica not being found objectionable. In the tests given below in order that they may be comparative, only those made with aluminate approaching the mono-calcic formula are given.

Tests Showing the Effect of the Addition of Calcium Aluminate to Mixtures of Hydrated Lime and Argillaceous or Silicious Material Without Any Treatment of These Materials Beyond Pulverization.



Line A shows the average results obtained on a number of tests made with the California shale described in the detailed tests and covers variations in the amount of lime added and the percentage of aluminate, which varies from 7 to 12 per cent.; the lime varying from 29 to 45 per cent. of the mass. The tests given are the average breaking strength of the briquettes, mixed one part of the mixture of clay, lime, accelerator and retarder and three parts of stand-ard sand, by weight. Lime B shows graphically the tests obtained on a mixture of one-third shale, one-third hydrated lime and one-third aluminate. This mixture was mixed with three parts, by weight, of sand. The briquettes in each case were one day in air, balance of time in water.

	Shale. Per cent.	Calcium aluminate. Per cent.	Hydrated lime. Per cent.
Silica (SiO_2) Al_2O_3	69.02	1.16	1.02
Alumina (Al_2O_3)	5.31	62.41	.42
Iron oxide (Fe_2O_3)	2.25	4.51	
Lime (CaO)	6.22	31.46	73.58=96.87 Ca(OH)2
Magnesia (MgO)	3.12	.72	1.12
Loss in ignition	11.96	.02	23.66

The shale was exceedingly fine grained, no silica be-ing present as sand. A mixture was made from these materials in the following proportion:

45 parts hydrated lime,
40 parts shale,
12 parts aluminate,
12 parts aluminate,
3 parts plaster of Paris.

This mixture when tested in the usual manner for physical properties gave the following results:

Tensile Tests.—One part mixture, 3 parts Ottawa sand; 1 day in air, balance of time in water. Setting time; initial set, 2 hours; final set, 4 hours.

48 hours	7 days.	28 days.	3 months.
80 pounds	100 pounds	300 pounds	370 pounds
75 pounds	100 pounds	320 pounds	380 pounds
80 pounds	120 pounds	300 pounds	390 pounds
av. 78 pounds	106 pounds	307 pounds	380 pounds

Another mix was made from the above materials in the following proportions:

59 parts shale,
29 parts hydrated lime,
12 parts aluminate.

This mixture when tested for tensile strength in the usual manner gave the following results:

Tensile Test.—One part mixture, 3 parts Ottawa sand, 1 day in air, balance of time in water.

7 days.	28 days.	3 months.	6 months.
100 pounds	250 pounds	350 pounds	415 pounds
110 pounds	265 pounds	335 pounds	320 pounds
105 pounds	260 pounds	340 pounds	405 pounds
av. 105 pounds	259 pounds	342 pounds	390 pounds

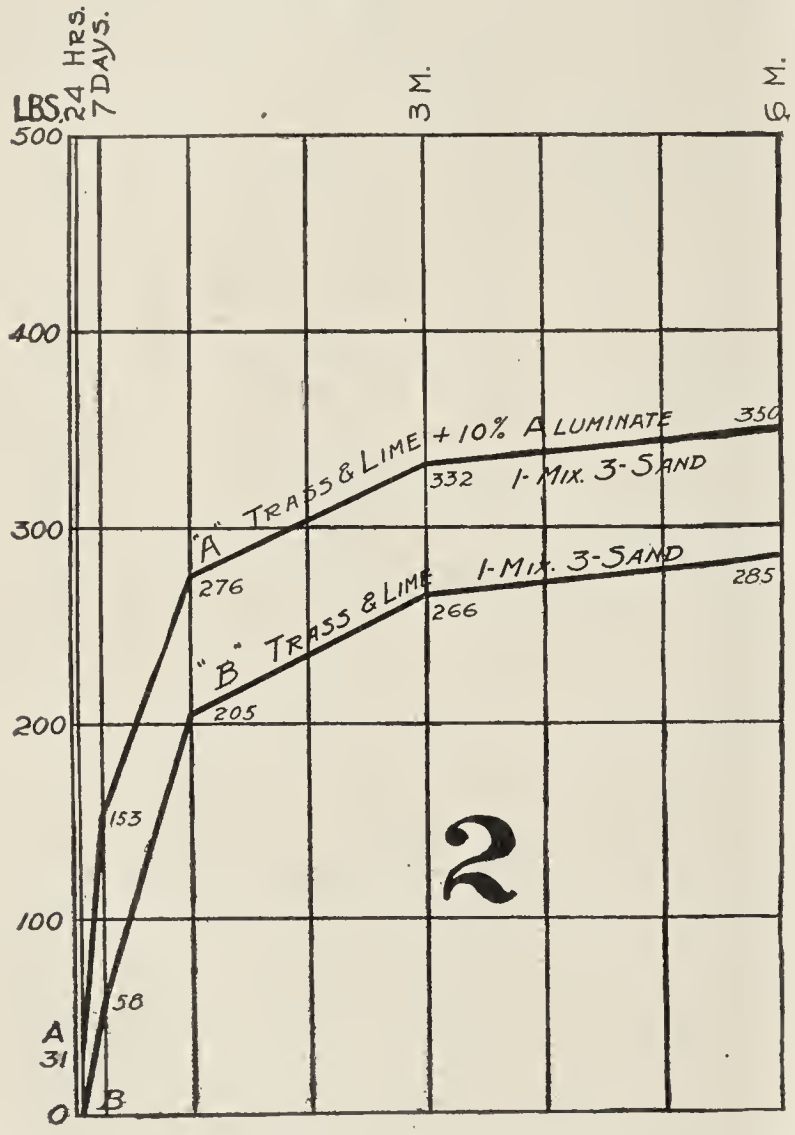


Fig. 2 shows the average results obtained on various tests of mixtures of trass, hydrated lime and calcium aluminates, the mixtures varying from thirty parts of lime to sixty parts of trass, to fifty parts of lime to fifty party parts of tass, to which was added 10 per cent calcium aluminate. The tests show the strength obtained from briquettes made from the above mixture to which were added three parts of standard sand, briquettes being one day in the air, balance of time in water. Line A shows the average strength of the trass—lime mixtures to which aluminate has been added. Line B shows the average strength of the trass-lime mixtures without the addition of aluminate.

Another mixture was made of the same materials in the proportions of:

1/3 shale,
1/3 hydrated lime,
1/3 aluminate.

This material when tested in the usual manner gave the following results:

Setting time; initial, 35 minutes, final, 1 hour and 15 minutes. Soundness: air, O. K.; cold water, O. K.; steam, O. K.; boiling, O. K.

Tensile Tests.—One part mixture, 3 parts Ottawa sand, 1 day in air, balance of time in water.

24 hours.	7 days.	28 days.	3 months.	6 months.
150 pounds	220 pounds	300 pounds	360 pounds	450 pounds
170 pounds	225 pounds	330 pounds	410 pounds	410 pounds
160 pounds	230 pounds	325 pounds	380 pounds	425 pounds
av. 160 pounds	225 pounds	318 pounds	380 pounds	428 pounds

Another test was made on the same materials using 7 parts aluminate, 45 parts lime, 45 parts clay and 3 parts plaster. This gave the following physical test:

Setting time; initial set, 2 hours; final set, 4 hours.

Tensile Tests.—One day in air, balance of time in water.

neat.	7 days.	1 cenemt. 3 sand.
65		85
70		90
av. 68		av. 88
neat.	28 days.	1 cement, 3 sand.
225		320
245		350
av. 235		av. 335

(See Fig. 1 and legend, page 187.)

Test of Clay from Wisconsin Hydrated Lime and Calcium Aluminate.

	Clay. Per cent.	Aluminate. Per cent.	Hydrated lime Per cent.
Silica (SiO_2)	68.84	1.16	1.02
Alumina (Al_2O_3)	12.07	62.41	.42
Iron oxide (Fe_2O_3)	7.17	4.51	
Lime (CaO)	1.16	31.46	73.58=96.87 Ca(OH)$_2$
Magnesia (MgO)	1.37	.72	1.12
Loss on ignition	9.54	.02	23.66

This was rather coarse-grained field clay containin some sand.

A mixture of the above materials was made in th following proportions:

35 parts clay,
55 parts hydrated lime,
7 parts aluminate,
3 parts plaster of Paris.

Setting time: initial, 1 hour and 30 minutes; final, hours and 30 minutes.

Water Exposure.

7 days.	28 days.	3 months.
85 pounds	140 pounds	100 pounds
95 pounds	130 pounds	120 pounds
100 pounds	145 pounds	120 pounds
av. 93 pounds	138 pounds	113 pounds

Air Exposure.
1 cement, 3 sand.

7 days.	28 days.	3 months.
100 pounds		100 pounds
130 pounds		110 pounds
115 pounds		110 pounds
av. 115 pounds		107 pounds

A mixture when then made from finely ground sand stone, hydrated lime, and calcium aluminate, analyzing a follows:

	Sandstone. Per cent.	Calcium aluminate. Per cent.	Hydrated lim Per cent.
Silica (SiO_2)	90.26	1.15	1.02
Alumina (Al_2O_3)	3.82	62.41	.42
Iron Oxide (Fe_2O_3)			
Lime (CaO)	.60	31.46	73.58=96.87 Ca(OH)$_2$
Magnesia (MgO)	.42	.72	1.12
Loss on ignition	.90	.02	23.66

The sandstone was ground to a fineness of 92 pe cent. on No. 200 sieve.

These materials were mixed in the following propo tions:

35 parts ground sand,
55 parts hydrated lime,
10 parts aluminate.

when treated in the usual manner gave the following physical tests:

Setting time: initial, 2 hours and 50 minutes; final, 8 hours.

7 days.	28 days.	3 months.
75 pounds	50 pounds	100 pounds
70 pounds	60 pounds	120 pounds
75 pounds	50 pounds	120 pounds
av. 72 pounds	53 pounds	115 pounds

Tensile Test.—One part mixture, 3 parts Ottawa sand, air exposure.

7 days.	28 days.
95 pounds	160 pounds
110 pounds	150 pounds
100 pounds	150 pounds
av. 101 pounds	153 pounds

Tests Showing Effect of Addition of Calcium Aluminate To Trass and Lime Mortars.

The materials used in the investigation were Trass from D. Servas & Sohne Koln a Rhein, Germany, high calcium hydrated lime and calcium aluminate made in the Laboratories of the Henry S. Spackman Engineering Co., Philadelphia, Pa.

These materials were found to contain:

Trass.	Per cent.	Hydrated lime.	Per cent.
Silica (SiO_2)	55.62	Silica SiO_2	1.02
Alumina (Al_2O_2)	22.06	Alumina (Al_2O_3)	.42
Iron oxide (FeO)	1.64	Iron oxide (Fe_2O_2)	
Lime (CaO)	1.82	Lime (CaO)	73.58=96.87
Magnesia (MgO)	.54		Ca (OH_2)
Soda Na_2O)	6.01	Magnesia (MgO)	1.12
Potash (K_2O)	1.71	Loss on ignition	23.66
Loss in ignition	10.16		

Calcium Aluminate.	
Silica (SiO_2)	3.40 per cent.
Alumina (Al_2O_3)	45.16 per cent
Iron oxide (Fe_2O_3)	12.80 per cent.
Lime (CaO)	35.40 per cent.
Magnesia (MgO)	2.72 per cent.
Loss on ignition	64 per cent.

Mixture, 10 parts aluminate, 30 parts hydrated lime, 60 parts trass.

Tensile Test.—One part mixture, 3 parts standard Ottawa sand, 24 hours in air, balance of time in water, in pounds per square inch.

24 hours.	7 days.	28 days.	3 months.	6 months.
25 pounds	140 pounds	280 pounds	310 pounds	310 pounds
25 pounds	145 pounds	290 pounds	315 pounds	320 pounds
25 pounds	150 pounds	285 pounds	295 pounds	330 pounds
av. 25 pounds	145 pounds	285 pounds	307 pounds	320 pounds

Mixture, 10 parts aluminate, 45 parts hydrated lime, 45 parts trass.

Tensile Tests.—Twenty-four hours in air, balance of time in water in pounds per square inch.

Neat.

24 hours.	7 days.	28 days.	3 months.	6 months.
65 pounds	200 pounds	230 pounds	300 pounds	300 pounds
75 pounds	200 pounds	250 pounds	320 pounds	310 pounds
av. 70 pounds	200 pounds	240 pounds	310 pounds	305 pounds

One Part Mixture to Three Parts Standard Sand.

24 hours.	7 days.	28 days.	3 months.	6 months.
55 pounds	205 pounds	310 pounds	380 pounds	380 pounds
60 pounds	210 pounds	300 pounds	360 pounds	400 pounds
av. 58 pounds	208 pounds	305 pounds	370 pounds	390 pounds

Tensile Test of Trass and Lime Without the Addition of Aluminate.

Mixture, 1 part hydrated lime, 2 parts trass.

Tensile Tests.—One part mixture, 3 parts Standard Ottawa Sand.

24 hours.	7 days.	28 days.	3 months.	6 months.
no strength	60 pounds	210 pounds	250 pounds	280 pounds
no strength	60 pounds	200 pounds	280 pounds	285 pounds
no strength	50 pounds	205 pounds	270 pounds	290 pounds
	av. 58 pounds	205 pounds	266 pounds	285 pounds

(See Fig. 2 and legend, page 188.)

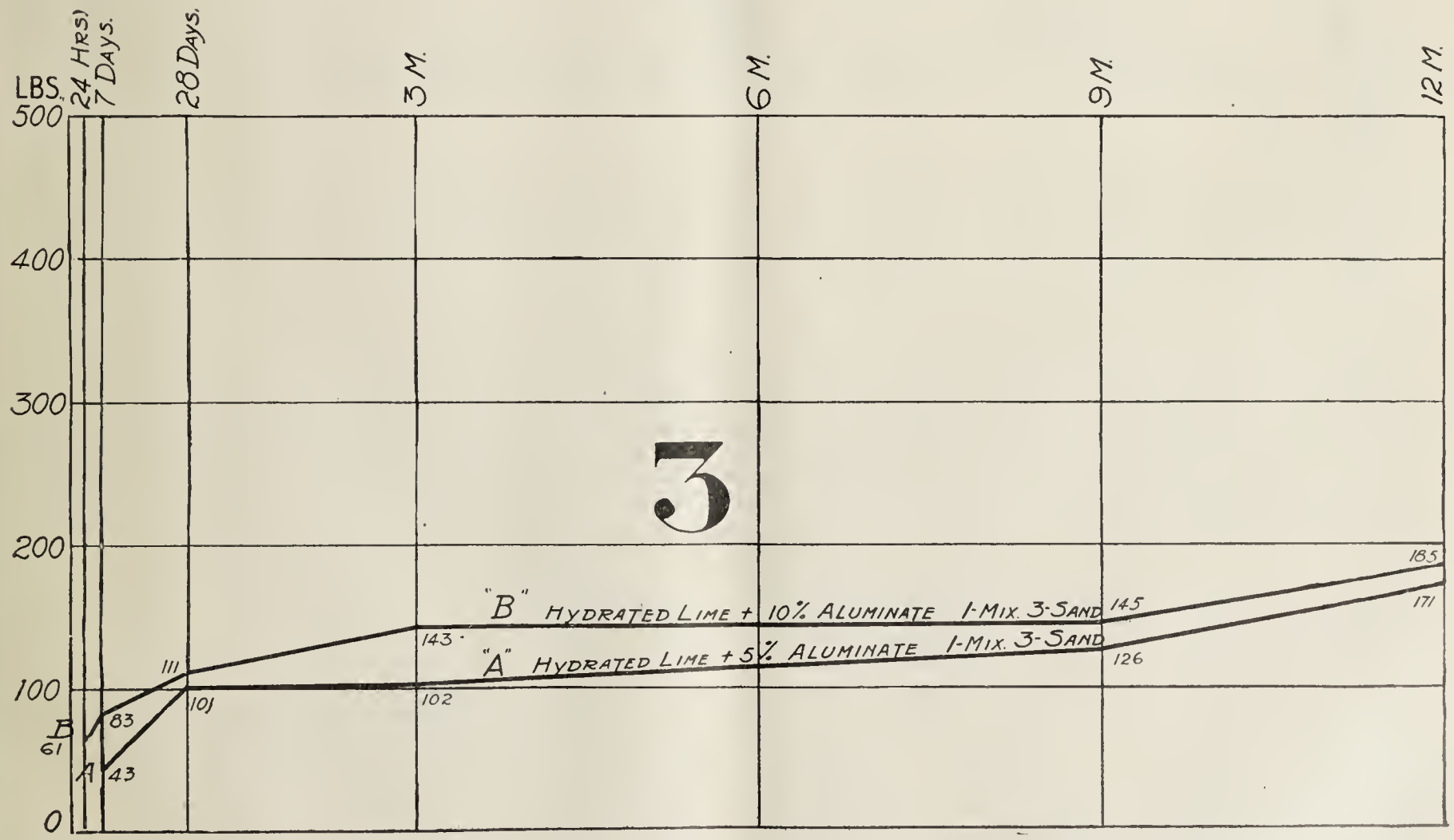


Fig. 3 shows the average strength obtained from a number of tests made on hydrated limes to which 5 and 10 per cent. aluminate has been added. Both high calcium and dolometic limes were tested and the results from these grouped together. Line A shows the tensile strength developed by hydrated limes to which 5 per cent. calcium aluminate was added, mixed one part mixture to three parts standard sand. Line B shows the strength developed by the same materials when 10 per cent. calcium aluminate was added, mixed one part mixture to three parts standard sand.

Tests Made to Show the Effect of the Addition of Calcium, Aluminate to Hydrated Limes.

Analyses of Limes and Calcium Aluminate.

	Calcium aluminate. Per cent.	High calcium lime. Per cent.	Magnesian lime. Per cent.
Silica (SiO_2)	9.14	2.77	2.30
Alumina and Iron Oxide (R_2O_3)	56.80	0.99	0.92
Lime (CaO)	31.32	70.67	43.34
Magnesia (MgO)	.80	1.38	29.46
Loss in ignition	2.08	24.10	24.14

The aluminate was mixed with the high calcium hydrate in proportion to 5 parts by weight aluminate 93 parts hydrated lime and 2 parts plaster of Paris.

Tensile Test.—One part mix as above to 3 parts by weight Standard Ottawa Sand in pounds per square inch —air exposure.

7 days.	28 days.	3 months.	9 months.	12 months.
45 pounds	125 pounds	120 pounds	130 pounds	155 pounds
50 pounds	130 pounds	120 pounds	130 pounds	180 pounds
55 pounds	120 pounds	115 pounds	130 pounds	180 pounds
av. 50 pounds	125 pounds	118 pounds	130 pounds	172 pounds

The aluminate was mixed with high calcium hydrate as above in proportion 10 parts aluminate, 88 parts hydrated lime, 2 parts plaster of Paris.

Tensile Test.—One part mixture, 3 parts standard Ottawa Sand in air, pounds per square inch.

7 days.	28 days.	3 months.	9 months.	12 months.
85 pounds	170 pounds	150 pounds	120 pounds	200 pounds
90 pounds	150 pounds	185 pounds	135 pounds	175 pounds
70 pounds	145 pounds	120 pounds	120 pounds	170 pounds
av. 82 pounds	155 pounds	152 pounds	125 pounds	182 pounds

The aluminate was mixed with high magnesian hydrated lime as above in proportion by weight of 10 parts aluminate, 88 parts hydrated lime, 2 parts plaster of Paris.

Tensile Test.—One part mixture, 3 parts standard sand in air.

7 days.	28 days.	3 months.	9 months.	12 months.
70 pounds	155 pounds	155 pounds	120 pounds	165 pounds
65 pounds	130 pounds	165 pounds	125 pounds	190 pounds
70 pounds	120 pounds	170 pounds	115 pounds	210 pounds
av. 68 pounds	135 pounds	163 pounds	120 pounds	188 pounds

The aluminate was mixed with high magnesian hydrated lime in proportion by weight of 5 parts aluminate, 93 parts lime, 2 parts plaster of Paris.

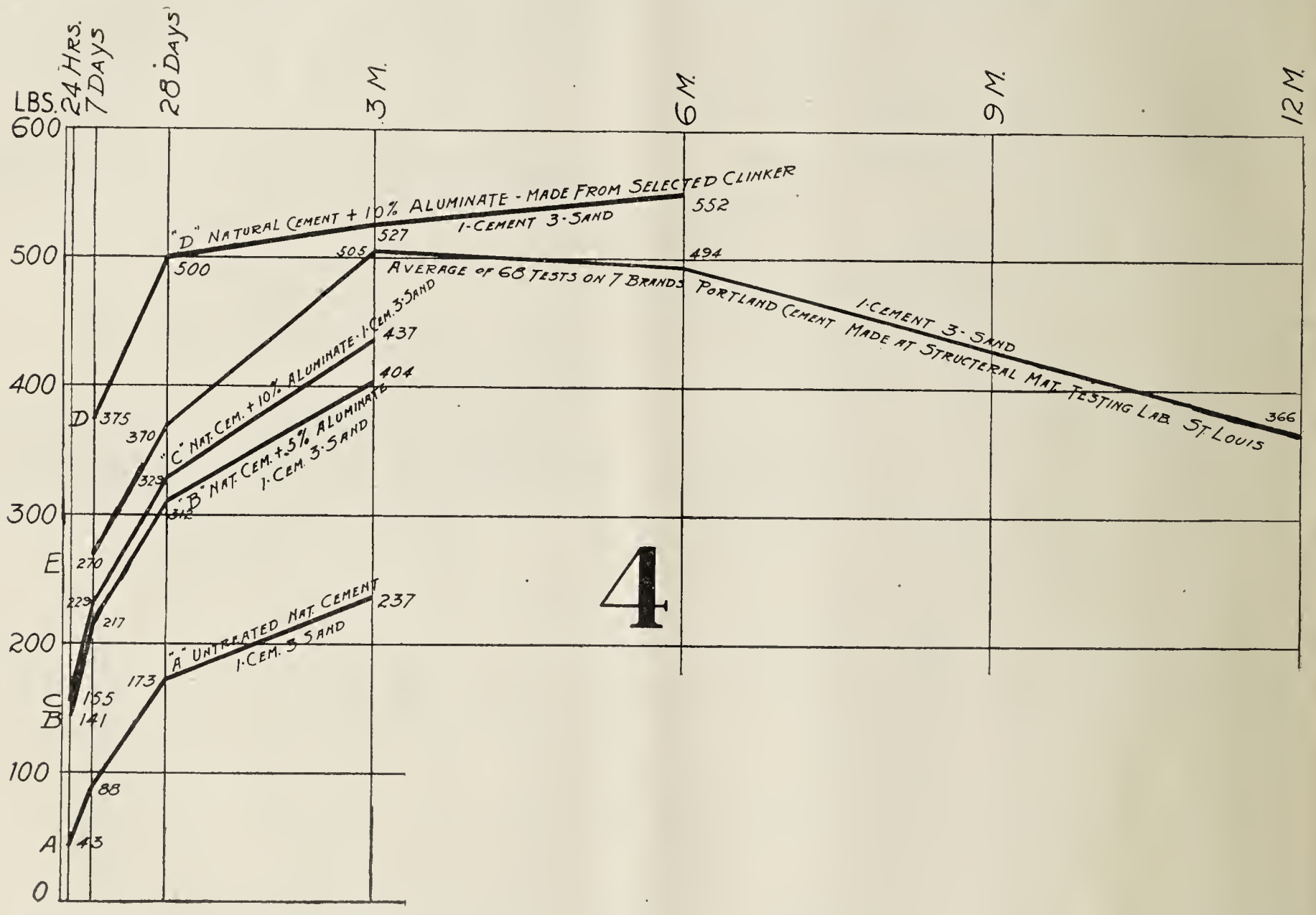


Fig. 4 shows the results obtained by the addition of calcium aluminate to natural cements. Line A shows the average strength of six commercial samples of natural cement tested one part cement, three parts standard sand. Line B shows the average strength developed by tests on these six samples of commercial cement after the addition of 5% of calcium aluminate. Line C shows the average results obtained from tests of the above six samples with a ten per cent. addition of calcium aluminate. Line D shows the results obtained by the addition of 10% aluminate to a natural cement made from selected perfectly burned rock. Line E shows average of 68 tests on seven brands Portland cement made at Structural Materials Testing Laboratory St. Louis. In every instance the cement after treatment was mixed one part cement to three parts standard sand and the briquettes were exposed one day in air and the balance of time in water.

Tensile Test.—One part mixture, 3 parts standard sand in air.

7 days.	28 days.	3 months.	9 months.	12 months.
35 pounds	76 pounds	65 pounds	125 pounds	145 pounds
35 pounds	80 pounds	95 pounds	100 pounds	195 pounds
40 pounds	80 pounds	110 pounds	140 pounds	140 pounds
av. 37 pounds	78 pounds	90 pounds	122 pounds	170 pounds

Another test was made using an aluminate prepared after we had become more familiar with its manufacture, mixed in proportions of 10 parts aluminate, 88 parts high calcium hydrated lime, 2 parts plaster of Paris.

Tensile Test.—One part mixture, 3 parts standard Ottawa sand, in air.

48 hours.	7 days.	28 days.	3 months.	6 months.
49 pounds	94 pounds	96 pounds	120 pounds	130 pounds
61 pounds	118 pounds	94 pounds	130 pounds	135 pounds
63 pounds	91 pounds	92 pounds	125 pounds	145 pounds
v. 61 pounds	101 pounds	94 pounds	125 pounds	136 pounds

A test was then made using the last aluminate to termine the hydraulic properties. A mixture of 10 rts aluminate and 90 parts hydrated lime, gave when sted in the usual manner, 1 part mixture, 3 parts ındard sand, I day in air, balance of time in water.

7 days.	28 days.	3 months.
5 pounds	30 pounds	50 pounds
5 pounds	35 pounds	60 pounds
5 pounds	40 pounds	50 pounds
av. 5 pounds	35 pounds	53 pounds

A mixture of 17 parts aluminate, 3 parts plaster of ıris, 80 parts hydrated lime.

Tensile Test.—One part mixture, 3 parts standard nd, 1 day in air, balance of time in water.

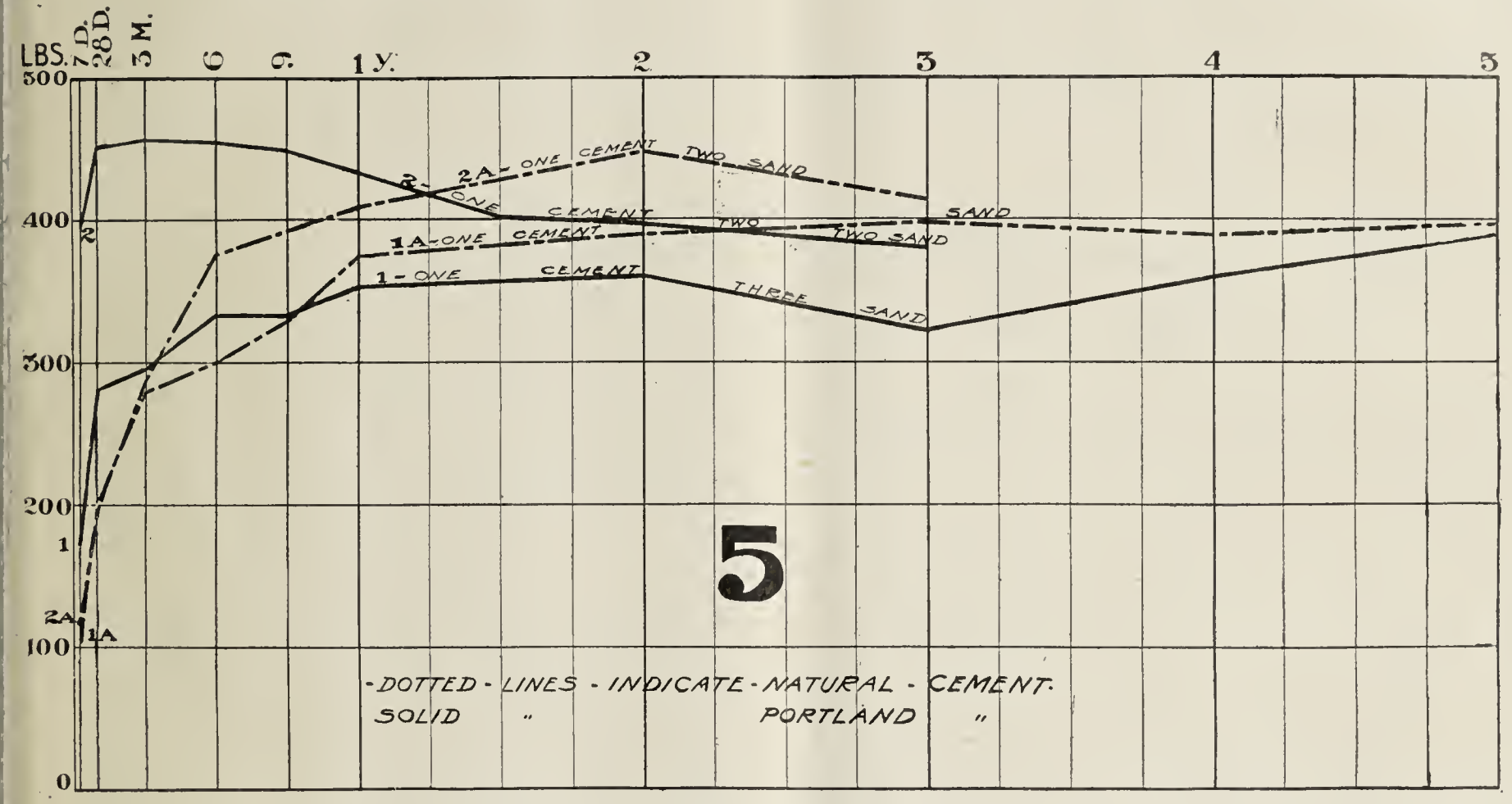


Fig. 5 shows a comparative long time test between natural and Portland cements. Line 1 shows the average strength of 14 brands of Portland cement. Line 1A shows the average strength developed by 9 samples of natural cement. The figures from which these curves are plotted were taken from the Report of the Operation of the Engineers Department of the District of Columbia for the year ending June 30, 1900 and the Portland cements used in these tests were made between 1885 and 1888 and were with possibly three exceptions, cements burned in the old fashioned set kilns. The average numbers six American cements and eight imported cements. Line 1 shows the average strength developed by a mixture of one part cement to three parts sand, one day in air, balance of time in water. Line 1A shows a mixture of one part cement to two parts sand, one day in air, balance of time in water. The data used in plotting lines 2 and 2A are taken from the Metropolitan Water and Sewage Board, Fifth Annual Report, January 1, 1906. Line 2 shows the average strength developed by eleven Portland cements mixed one part cement to two parts sand. These cements were probably all rotary kiln cements made between 1901 and 1903. Line 2A shows the strength developed by one brand of natural cement of which 182,480 bbls. were tested. This was mixed one part cement to two parts sand. All the briquettes were one day in air, balance of time in water. Line 2 shows the typical drop of Portland cement tested in tension referred to.

7 days.	28 days.	3 months.
65 pounds	120 pounds	100 pounds
70 pounds	90 pounds	100 pounds
50 pounds	105 pounds	130 pounds
av. 62 pounds	105 pounds	110 pounds

(See Fig. 3 and legend, page 197.)

Tests Made to Show the Effect of Addition of Calcium Aluminate to Natural Cement.

	Analyses. Natural cement. Per cent.	Aluminate. Per cent.	Hydrated lime. Per cent.
ilica (SiO_2)	22.22	1.16	1.02
lumina (Al_2O_3)	9.99	62.41	0.42
on oxide (Fe_2O_3)	2.63	4.51	
ime (CaO)	54.72	31.46	73.58=96.87 $Ca(OH)_2$
lagnesia (MgO)	2.92	0.72	1.12
oss in ignition	5.74	0.02	23.66

The natural cement was received in the form of clinker and to this was added 5 per cent of aluminate, 5 parts hydrated lime. The material was then ground and 2 parts plaster of Paris incorporated therewith. This material when tested according to the standard specifications for cement gave the following results:

Fineness; passing No. 100 sieve, 100 per cent.; passing No. 200 sieve, 91 per cent.; Setting time: initial set, 1 hour; final set, 1 hour and 30 minutes.

Tensile Test.—One part mixture, 3 parts standard Ottawa sand, in pounds per square inch, 1 day in air, balance of time in water.

24 hours.	7 days.	28 days.	3 months.	6 months.
205 pounds	350 pounds	450 pounds	495 pounds	470 pounds
210 pounds	360 pounds	460 pounds	515 pounds	545 pounds
195 pounds	360 pounds	460 pounds	550 pounds	495 pounds
av. 203 pounds	358 pounds	458 pounds	520 pounds	503 pounds

The cement was then mixed in the proportions of 80 parts clinker, 10 parts calcium aluminate, 10 parts hydrated lime, 2 parts plaster of Paris.

Tensile Test.—One part mixture, 3 parts standard Ottawa sand, in pounds per square inch, 1 day in air; balance of time in water.

Tensile Tests.—One part mixture, 3 parts Ottawa sand, 1 day in air, balance of time in water.

7 days.	28 days.	3 months.	6 months.
375 pounds	500 pounds	515 pounds	595 pounds
380 pounds	490 pounds	520 pounds	420 pounds
370 pounds	510 pounds	545 pounds	640 pounds
av. 375 pounds	500 pounds	527 pounds	552 pounds

The above tests were then repeated on commerical samples of natural cement to which was added the calcium aluminate and lime, six different samples being

tested. These were mixed in the proportions of 90 parts cement, 5 parts calcium aluminate, 5 parts lime. To this mixture 2 parts plaster of Paris was added. The average results obtained of this series of tests are as follows:

Fineness: passing No. 100 sieve, 99 per cent.; passing No. 200 sieve, 89 per cent.; Setting time: initial set, 1 hour and 14 minutes; final set, 2 hours and 9 minutes.

Tensile Test.—One part mixture, 3 parts standard Ottawa sand, in pounds per square inch, I day in air, balance of time in water.

Average of Fifteen Tests.

24 hours.	7 days.	28 days.	3 months.
A-145 pounds	222 pounds	304 pounds	463 pounds
B-141 pounds	217 pounds	312 pounds	404 pounds

The same cements were then tested with the addition of 10 parts aluminate, 10 parts hydrated lime, 2 parts of plaster of Paris being added. The average of these tests is as follows:

Fineness: passing No. 100 sieve, 99 per cent.; passing No. 200 sieve, 91 per cent.; Setting time: initial set, 54 minutes; final set, 1 hour and 40 minutes.

Tensile Test.—One part mixture, 3 parts standard Ottawa sand. In pounds per square inch. One day in air, balance of time in water.

Average of Six Tests.

24 hours.	7 days.	28 days.	3 months.
C-155 pounds	229 pounds	329 pounds	437 pounds

Average of Six Sand Tests Without Treatment.

24 hours.	7 days.	28 days.	3 months.
43 pounds	88 pounds	173 pounds	237 pounds

(See Fig. 4 and legend, page 199.)

In view of the fact that the investigation is still in progress, no specific conclusions have been drawn by the writer as to the exact manner in which the addition of the aluminate produces the striking result shown by the tests given.

The tests quoted, however, are typical and are borne out by the many other tests on similar materials made in the course of the extended investigations of the subject by the writer, but the fact that no explanation of how the aluminate acts is at present forthcoming is not a bar to the utilization of cement produced by this process. This is evinced by the fact that after many years of use and careful study the exact reactions taking place and compounds formed during the induration of Portland cement are still unknown. This is due to the fact that it is extremely difficult to isolate and identify hydraulic compounds which undergo decomposition or alteration on contact with water and to the fact that the crystals formed by the induration of cements are largely submicroscopic.

Considering the commercial applications and technical use of the results shown by the preceding tests, that is, the indication that the addition of a small percentage of calcium aluminate gives to materials possessing the property of hardening on being mixed with water, greatly increased strength, we will consider first the application of this discovery to limes.

In ordinary building construction, lime is used for the laying of the foundation walls, brick work, and for plastering the interior surfaces of the building. Formerly the lime to be used for building purposes was brought to the building during the early stages of construction, slaked with water, and allowed to run off into large vats or beds where, stored in the presence of an excess of moisture, it become thoroughly hydrated. The lime-paste or putty so formed was mixed with sand and in this condition used for the laying of the walls of the building and their subsequent plastering.

In more recent years, in order to save the space occupied by the lime beds, especially in connection with urban construction, the lime is delivered to the building in a hydrated form as a dry powder. The use of hydrate lime is more common in Europe than in this countr Hydrated lime is produced by adding to the lime c slaking enough water to satisfy the chemical requir ments of the lime and supply the loss by evaporatio with an allowance of two or three per cent. excess t provide for variation in the amount lost by evaporatio This reduces it to the form of a very finely divide powder, which may be mixed with sand and water an acts, in general, in the same manner as the lime-putt prepared by the older methods; with the exception tha by the process of dry hydration the lime seems to los part of its plasticity and will not carry the same amou of sand or work as readily under the trowel.

According to the generally accepted theory, th strength of lime mortars depends on the cohesion of th crystalline compounds formed during setting and upo their adhesion to one another and to the particles of san with which they are mixed. The first hardening is du to desiccation which, unless sufficient sand is added, i accompanied with considerable shrinkage in volume an consequent cracking. The lime in the mortar is preser partly in a solid condition between the grains of san as calcium hydrate and partly in solution, During drying carbon dioxide is absorbed by this solution, forming crys talline calcium carbonate which under certain condition may prevent the absorption of further quantities of ca bon dioxide. Frequent instances are on record of lim mortar being found after a period of many years in th interior of heavy walls, in absolutely the same conditio as when it was first used. This is due to the formatio of a crust or skin of crystallized calcium carbonat which prevents the access of air and the further absor tion of carbon dioxide and also the drying of th mortars by evaporation. In a closed chamber, for in stance, the absorption of carbon dioxide by fresh morta soon ceases. The absorption of carbon dioxide is als dependent on the presence of moisture.

It will be seen from this brief description of th hardening of lime mortars that the strength attained b them is variable and governed by local conditions.

For plastering purposes lime has been largely sup planted by what are commonly known as "patent plas ters;" these have for their base calcined gypsum an harden by crystallization. Pure plaster of Paris is, how ever, not available for work of this kind, owing to th interference of the rapidity of set with the smooth work ing of the mortars made from it. This is overcome b the addition of lime and retarders which may be eithe organic or inorganic. Such plasters are commonly sup plied to the building in the form of a dry powder alread mixed with the necessary amount of sand and hair re quired, other materials acting in the form of a stretch er are frequently present. These plasters harden wit considerable rapidity and allow of the early completio of the buildings and do away with the necessity o slaking the lime on the work. They are, however, subjec to several objections. It is claimed by their critics tha they are lacking in durability and also are more expensiv to apply owing to their low sand-carrying qualities an to the fact that the lack of plasticity prevents the me chanics from covering the same area of wall in th course of a day's labor. These plasters are also criticized for their tendency to warp and crack, the set taking plac ing before the lath has had time to expand after bein moistened by the mortar. Yet in spite of these objec tions, owing to the slow hardening of lime plasters an the time and space required in their preparation by th old methods, the patent plasters have made great in roads into the trade of the lime burners.

The addition of a small percentage of calcium alumin

e to hydrated lime as demonstrated by use in actual ilding work will give to this material all the advantages a hard wall plaster without its objections and restore hydrated limes the plasticity and sand-carrying power limes slaked in the old way. The set being more grad- al allows of ample opportunity for any expansion of ie work due to the moisture, while the hardening, hich is reasonably quick, will continue with years and ie plaster after acquiring its initial set is not damaged water, but on the contrary its strength is increased. his makes lime treated by aluminates available for stuc- oing buildings and other out-door work and prevents amage to plaster through leaking of the roof or plumb- g.

These advantages will enable the lime burner to meet a direct competitive basis the manufacturer of patent lasters.

Considering next the use of aluminated lines for mor- rs in the laying of stone and brick walls, etc., the addi- on of calcium aluminate, with or without clay ingred- nts, to hydrated limes will enable the lime burner to ompete with the cement manufacturer in supplying mor- r for such construction where the work is not below ater.

While the making of cement by the addition of alum- nate has not yet reached a commercial scale, experi- ental work done indicates that equally good results ill be attained as with plasters. If this proves to be ie case and it is shown beyond possibility of doubt that ie addition of a small percentage of aluminate to nat- ral cements or to mechanical mixtures of hydrated lime nd Puzzuolanic material will produce a cement having ie strength of Portland cement at earlier periods com- ined with the unquestioned durability and stability of ie natural and Puzzuolanic cements, the effect on the ement industry will be revolutionary.

As you all probably know the past fifteen or twenty ears have witnessed a phenomenal growth in the use nd production of cement and a decided change in the haracter of cements used. Prior to 1892, natural or hat was commercially known as Rosendale cements ere used even in the most important engineering con- truction. In 1893 there was used in the U. S., 8,211,181 arrels of natural cement and 2,066,558 barrels of Port- and cement of which only 547,440 barrels were of Amer- can production. From 1893 to 1900 the use of Port- and cement rapidly increased the U. S. Geological urvey reports for the latter year showing a consump- ion of 8,383,519 barrels of natural cement and 10,803,- 30 barrels of Portland cement of which 2,321,416 bar- els were imported. In 1907 51,000,000,000 barrels of ortland cement were used of which about 2,500,000 arrels were imported while the consumption of nat- ral cement fell to 2,887,700 barrels compared with 9,- 68,000 barrels used in 1899. This lack of growth and alling off in the use of natural cement has been some- hat of a puzzle to thoughtful students of the subject. opularly this decrease in the use of natural cement is ccounted for by the impression or belief that natural ements are greatly inferior to Portland cements, both n strength and durability; this view, however, is only artly true and owes its origin to a comparison between ests made on Portland cements of to-day and those made n the natural cements produced by the crude methods hat characterized the natural cement industry some years go and which to some extent are still prevalent; yet hese coarsely ground and carelessly combined and cal- ined cements proved equal to all strains imposed upon hem by such structures as the first Brooklyn Bridge, he Croton Aqueduct, and other work of like magnitude.

It is perhaps well, for the sake of clearness, at this point to explain briefly the difference between Portland cement and natural cement in their character and action. As defined in the standard specifications, "Portland cement is a finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials and to which no addition greater than three per cent. has been made subsequent to calcination" while natural cement is defined as "a finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off carbonic acid gas." Both cements owe their cementitious properties to the same chemical components,—lime, silica, and alumina—and, as ordinarily made, differ chemically only in the ratio these components bear to each other. Broadly speaking, the Portland cements of commerce contain about two parts of lime to one of clay matter while in natural cement the ratio is about one to one, although the lime may approach that contained in Portland cement. It will be thus seen that the temperature of calcination is the most distinctive feature that differentiates Portland from natural cements.

Turning now to the difference noted in their use, the first point to be considered is the time of set, which though part of the same phenomenon must not be confused with the ultimate hardening or induration, but must be considered only as the time required for the cement to enter into solution sufficiently for the starting of crystallization and might be better termed "period of plasticity."

Most natural cements set in a few minutes, while Portland cements require one or more hours. This difference is not, however, inherent, the slow set of Portland cement being due to the addition of a retarder after calcination and the quick set of the natural cements would yield to the same treatment and it seems surprising that the manufacturers have not followed the example of the Portland cement manufacturers, as this quickness of set is objectionable and is one of the causes for the Portland cements superseding, the natural cements.

The second and more important difference is the rapidity of induration. Portland cements, which are slow setting, harden very rapidly and at the seven-day period have, as a rule, acquired about 65 per cent. of their final tensile strength; the hardening continues more slowly until about the three-month period, after which there is, as a rule, no gain in strength, but a decrease when tested under tension.

Natural cements, on the contrary, are quick setting and slow hardening. At the seven-day period they rarely have over 25 per cent. of their ultimate strength and the increase is gradual and continuous to the six-month or year period. This condition is clearly shown by the accompanying diagrams.

It will thus be seen that the only superiority of Portland cement over natural cements is its slow setting qualities and rapid development of strength and if, as indicated by the tests read to you to-night and others made by the writer, a small addition of aluminate and retarding material will give to natural cements the slow-setting and quick-hardening properties resembling those of Portland, these cements may, by reason of their low cost and ease of manufacture and inexpensive works, regain not only the ground lost, but compete seriously with Portland cement.

In conclusion, I wish to express my indebtedness to my former associate, Dr. E. W. Lazell, and to Mr. E. L. Conwell who personally performed all the work involved in the analyses and tests, for their assistance in this investigation.

CONTROLLING PORTLAND CEMENT.

Vigilance required in Checking this Remarkable Material.

The extensive application that Portland cement has won in recent years as a building material testifies strongly to its merits, and is a most remarkable fact, when we consider that comparatively few years have passed since the introduction of this material.

The continued success of this material seems assured, in view of the additional knowledge and practical experience that has been gradually gained in regard to its usage, as well as the improved methods of its manufacture and tendency to concentrate in larger plants, and lastly in view of the more efficient control of the quality of this material, which has been made possible by the adoption of standard specifications and methods of testing.

In considering the last point, it can be said that the importance of subjecting Portland cement, in common with other materials of construction, to standard tests and inspection is becoming quite generally recognized and enforced. However, it may be stated for the benefit of those who are not familiar with the process of manufacturing cement, that while as a rule the greatest care is taken by the manufacturer to safeguard and maintain the uniformity of his product, the conditions governing it are such that at times considerable variations in regard to quality are liable to occur. The consumer depends naturally upon the vigilance exerted by the factory to ascertain whether or not cement of an inferior quality is being shipped. Further, we have to consider the number of different brands of Portland cement on the market at the present time, the individual characteristics of which may vary considerably, for instance, in regard to rate of hardening, and the relative merits of which can only be determined by the consumer from tests made by disinterested parties.

Proceeding upon this basis, the desirability of standardizing the methods for testing cement and adopting fixed requirements that cement should pass in order to be of acceptable quality, should be apparent. The present form of the standard specifications and methods of testing cement, as formulated and adopted by the American Society for Testing Materials and the American Society of Civil Engineers, are the combined efforts of a number of authorities on the subject, and while it cannot be expected that we all would agree on the various points taken up by them, it would be fair to presume that their findings represent the best obtainable compromise with the present state of knowledge.

It is therefore somewhat surprising that in a number of cases specifications and methods have been adopted which differ considerably from the standard, and which render it difficult for the manufacturer to maintain uniformity of his product, inasmuch as he may be called upon to meet conflicting requirements. However, it is probably only a matter of time when the standard specifications, with such changes as may be incorporated from year to year, in accordance with the results of increased knowledge on the subject, will be given a universal application.

In regard to the practical operation of the standard methods of testing cement, it can be said that the directions given are sufficiently complete and explicit, when in the hands of experienced men having the proper means for making the tests, practically to eliminate the question of personal equation, and consequently to permit of corrobative results being obtained by different operators.

In this article the subject of testing, proper, will not be further considered, but it may be in order here to take up briefly the matter of sampling cement which is not covered by the standard specifications, but has been left to the discretion of the engineer.

The methods to be used in sampling cement will depend principally upon the character of the work in question. In the case of important structural work it is generally required that a sample be taken from every ten to twenty barrels and a test made either on the sample separately or on an average of several samples, depending on the importance of the construction. For less important classes of work one sample is taken to represent 100 barrels, or a carload, or even larger amounts.

Considerable difference of opinion exists as to whether an average sample taken from a number of barrels, or a single sample obtained from one individual package, would be most efficient when the tests in both cases were to cover the same number of barrels. Arguments can be advanced in favor of both methods: The former, taking an average sample, gives naturally a truer expression of the bulk of the material, but on the other hand would not disclose so efficiently variations of quality in the individual barrels, as a sample from an inferior barrel would not, in many points, have any material effect on the average result of test when mixed with, say, five or six samples from other and better barrels.

As the principal purpose of the test is to disclose defects and varia tions in quality, if present, it is recom mended that under ordinary circum stances the latter methods, namely making the tests on individual sam ples, is the more severe test, and a the same time perfectly fair to th manufacturer, who guarantees ever barrel to pass standard requirements

It might be argued against this tha it would be practically impossible fo a few barrels to show any materia difference in quality from the bulk o a shipment, owing to the fact tha following routine, one and the sam shipment would generally be supplie from a single stockbin, which woul insure a fair mixing of the product.

While this generally, but not in variably, would apply on car ship ments made direct from the factory it does not hold good in the case o a great many deliveries from dealers where carloads shipped in at differen times and from different stockbins a the factory would naturally be mor or less mixed.

In addition to the ordinarily pre vailing system of sampling and test ing cement by the consumer, or hi representative, after delivery, of th product from the factory, either t the warehouse of the dealer, or "o the job," there has been adopted system whereby consumer, or hi representative, samples and tests th cement at the factory previous t shipment.

The principal advantage gained b this method, is that it eliminates th expense involved to the manufacture by a possible rejection of his produc after shipment has been made, and a the same time insures the custome against prolonged delays in deliverie of acceptable cement.—(C. F. Hei berg.)

BECOMES BUSINESS MANAGER OF MOTOR COMPANY.

Edward A. Kingsbury assume the position of business mana ger for the Chase Motor Truc Company in this city. For five year Mr. Kingsbury has been connecte with the Hudson Portland Cemen Company at Hudson and prior t that time was with the Empire Port land Cement Company at Warner.

The Chase Company is expandin rapidly and the office to be filled b Mr. Kingsbury is created to reliev some of the other officers whose du ties have increased two-fold durin the comparatively short career o this company. The company is in creasing daily its output of thre kinds of motor trucks, large order are being booked and steps will b taken this spring to enlarge the of fices in connection with the factor in South West Street.

METHODS OF ATTACHING SHAFTING AND MACHINERY FOR REINFORCED CONCRETE BUILDINGS.

The manner of attaching shaft hangers, pipes and machinery to beams and floors in a factory or mill building of the reinforced concrete type is a detail of considerable importance, so much so in fact, that often if no satisfactory scheme is explained to the owner he will not consider the use of reinforced concrete beams in his proposed building.

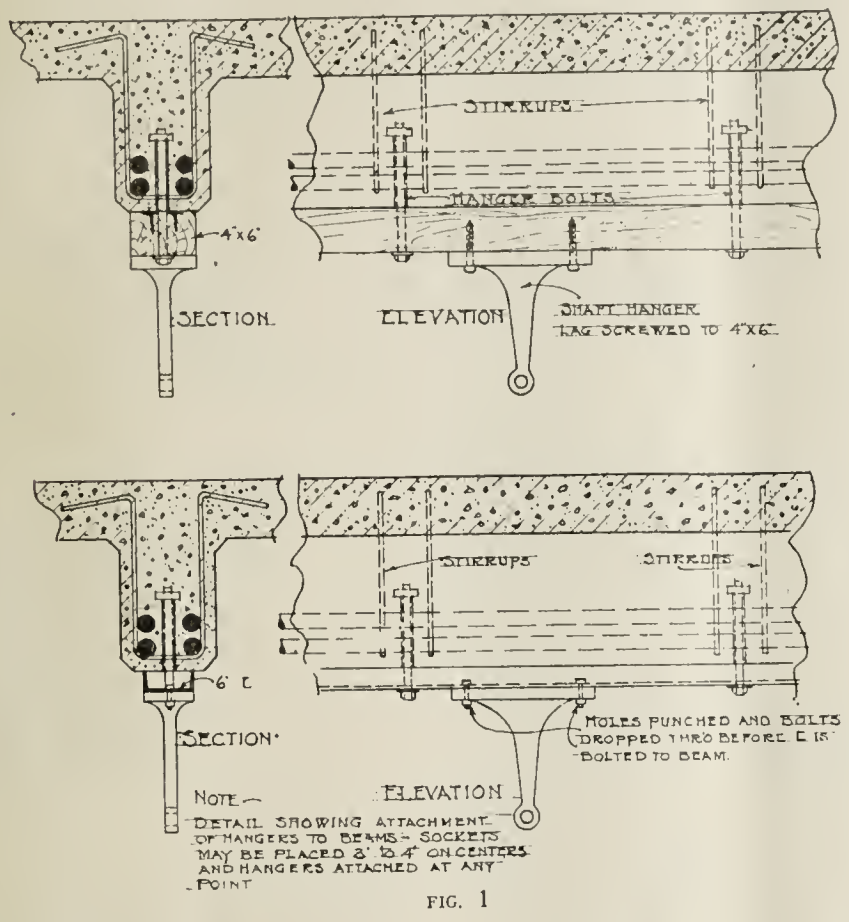


FIG. 1

In the ordinary mill constructed factory with wooden or steel floor beams there is no special difficulty in attaching hangers for shaftings and pipes or fastening machinery to the beams and floors in any desired location without any previous plans necessary and at a minimum cost. But in a concrete building the conditions are entirely different and it is much better to adopt some scheme for the installation of the machinery, piping, etc., before the building is constructed if we wish to obtain the best results in all respects.

Appliances for conveniently supporting hangers for pipes and shafting and for supporting motors and other machinery from the beams and ceiling probably require more previous planning and careful selection than is necessary for other phases of this subject. The method recommended by the engineer and adopted for use with this type of building should be one designed to best meet all the requirements so far as can be known of the building and its later equipment. It should be inexpensive, compact and simple in form, with not too many separate parts, and as flexible as possible to accommodate future changes in the line of shafting, additions or improved machinery, etc.

I have endeavored to collect and present for your consideration and discussion the different systems which are used by specialists in concrete construction.

One of the most common methods employed is to attach a hard pine timber to the under side of the concrete beam. This may be in any desired length, to which the shaft hangers are bolted or lag-screwed in and nut below, or by the use of sockets, inserts, sleeves and washer nuts imbedded in the concrete, into which the timber pieces are afterwards fastened. If the bolts are used, care should be taken to set and keep them vertical, also have them thoroughly anchored into the upper part of the beams.

Fig. 2 illustrates the long bolts with saddles and check nuts to hold them in position, which is quite essential. It is seldom that all the bolts projecting from the bottom of the beam are made use of and where not used they present an unsightly appearance, hence sockets or sleeves and washer nuts are often preferable. These can be kept in correct position with less trouble, are about the same cost and surely make a neater looking job.

In Fig. 3 we have shown the Unit socket, the well known insert for concrete work. This device serves also as a support and spacer for the beam rods, keeping them all properly spaced from each other and from the beam box or centering. Fig. 4 represents a socket sometimes used. It is made of a short piece of wrought iron pipe tapped out on the side to receive a lag screw or bolt. Holes are drilled near the top, through which a ¼-in. rod or stirrup is placed which should extend well up into the concrete. The socket itself is temporarily held in position before the concrete is placed by setting it over a wooden plug nailed to the centering. The stirrups are not easily kept in an upright position. For this reason this socket is not altogether satisfactory.

The socket shown in Fig. 5 is made of cast or malleable iron with a flanged top which serves to anchor it into the concrete. A vertical stirrup should be used with this socket if it is placed in a beam and is intended to support much load. If used as shown in the sketch it also acts as a support for the rods.

The Bigelow socket shown in Fig. 6 can be made use of for almost all supports in reinforced concrete work. It is a malleable casting made in many sizes, can be anchored as securely in the concrete as may be necessary by the use of stirrups and is more or less adjustable.

Another form of adjustable sockets or inserts for use in beams, principally, is shown in Fig. 7. These castings are made in convenient lengths and are set on the forms for centering before the concrete is placed. The slot in the bottom makes it possible to place hangers or bolts at any desired location along the length of the insert.

Fig. 1 illustrates the use of large

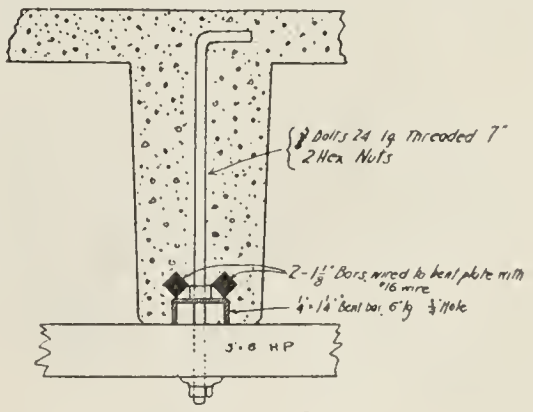


FIG. 2.

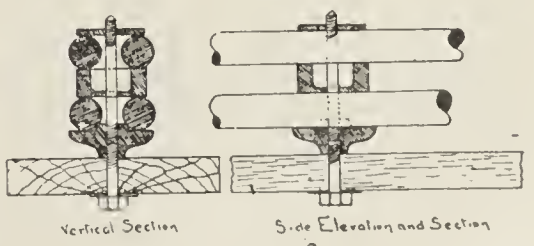


FIG. 3.

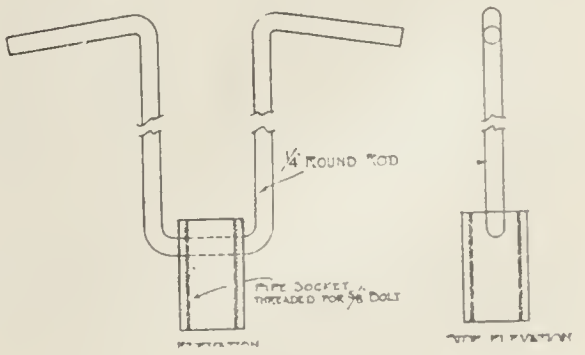


FIG. 4.

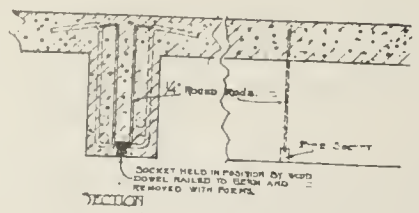
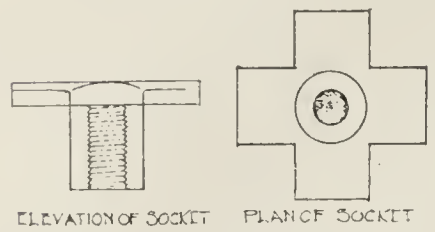


FIG. 4—GENERAL VIEW



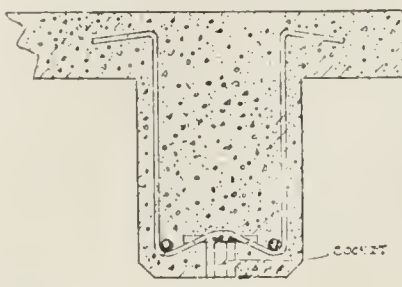


FIG. 5.

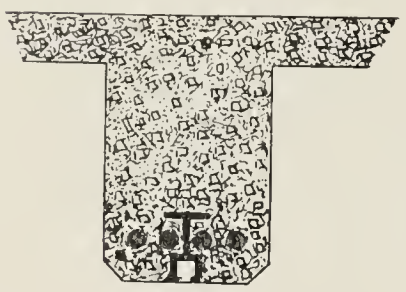


FIG. 6.

washer nuts imbedded in the upper part of the concrete beam, usually about 4 ft. on centers. These are temporarily held in position by a thin iron tube resting on the centering and by a bolt projecting through the hole in the bottom of the beam box. The washer nut is tightened down to the top of the tube which secures it firmly in an upright position. When the beam boxes or centering are taken down the bolts are easily unscrewed from the nut, leaving a clean passage through the concrete to the nut above, to which can be attached timber or iron stringers, on to which the shaft hangers can be fastened in the ordinary manner.

Figs. 8 and 9 illustrate two other methods used for attaching shaft hangers and machinery to beams. With either of these schemes the shaft hangers or other fittings can be bolted or clamped to the concrete structure without the use of wood timbers or iron bolsters if so desired. The method shown in Fig. 9 is one that was adopted by the United Shoe Machinery Co. in its extensive shops at Beverly, Mass.

Another method is suggested in Fig. 10, which can be made a strong and serviceable support for motors and machinery.

Other systems which have been used quite extensively by the Turner Construction Co., New York, are illustrated in Figs. 11 and 12.

When a bolt is used through the beam near the top a metal sleeve with a wooden core is concreted around to from the hole. These openings also permit the passage of pipes and wires. Large holes left in certain parts of beams and girders might cause weakness in the compressive side of the member. If so, an iron pipe sleeve of sufficient thickness should be used. It is rather difficult to always locate the holes through the beams during construction to conform exactly with future changes. Therefore, the system using the hooked hanger bolt inside the beam is more satisfactory and is one adopted for use in the Gair Publishing Co.'s building, Brooklyn. If the holes for the hook bolts are cut with a pneumatic drill it can be done at a nominal cost.

Blocks of wood are often set in the under side of concrete slabs to which are fastened wires and small sized pipes and wire conduits. This is not considered a suitable or permanent support. It is much better practice to use either expansion bolts or locate and place adjustable sockets and inserts in the concrete work. Often the conduits for wires are placed on the centering and imbedded in the concrete slabs. If the pipes are not too large and are located with due regard to the reinforcing metal there is no serious objection to this method. Piping for sprinklers is generally planned before the concrete work is started. It is therefore a simple matter to place inserts or sockets where needed in the concrete work, to which the pipes can be readily attached later on.

Large machines with heavy bases setting on the floor seldom require any special fastenings. It is usually sufficient to thoroughly grout with Portland cement mortar the base of the machine to the concrete floor. Small machines can be fastened directly to the concrete by expansion bolts or similar methods after the floors are concreted, the cost of drilling for these fastenings being a small item of expense. Sometimes, however, it may be necessary to bolt through the floor in order to hold certain machines rigidly. If through bolts are required the hole should, if possible, be located before the floor is concreted; otherwise, in cutting these holes through the floor reinforcing bars are liable to be encountered, which would cause more or less difficulty and might lead to serious trouble if cut off. In most cases machinery runs better and lasts longer if placed on solid foundations, and reinforced concrete floors are admirably adapted for machine shops. There are, however, exceptionable cases where machines seem to require more or less "give" on their bases in order to be most satisfactory in working and endurance. This is particularly true with certain textile machinery, and where a cushion is required a wood finished floor can be laid, or wooden timbers or bolsters can be fastened to the concrete floor-

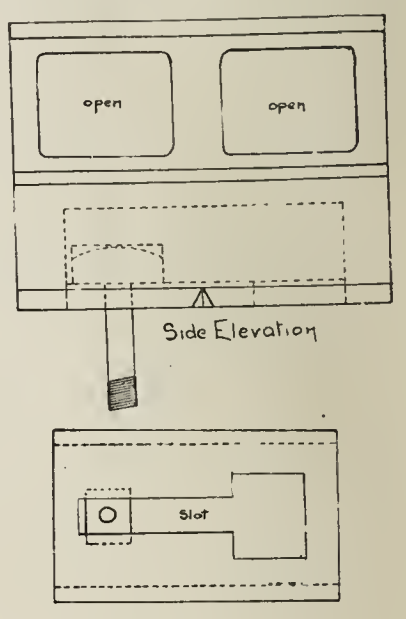


FIG. 7

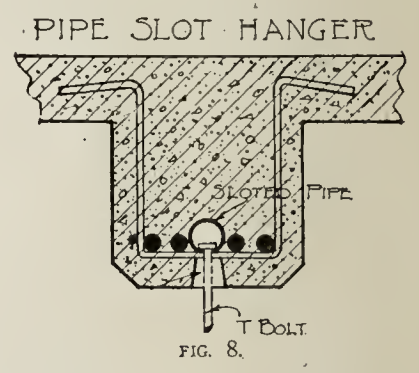


FIG. 8.

ing. It has also been suggested to use sheet cork or linoleum carpet under the base of machines in order to give elasticity of movement and also lessen the noise of running machinery. —(Wm. M. Bailey, Chief Engineer, Eastern Concrete Constr. Co., Boston, Mass.)

BIG ORDER FOR PORTLAND CEMENT.

One of the largest orders for cement for sidewalk improvements in the Birmingham (Ala.) district was that awarded to the Standard Portland Cement Co. of Leeds, Ala. This order was shipped in five trains of twenty-five cars each, 125 barrels of cement on each car. Another big order for the company's cement was thirty trains of twenty-five cars each, 120 barrels to each car, for the Tennessee Coal, Iron & Railroad Co., of Birmingham.

Inland Portland Cement Company, Spokane, has been incorporated for $1,000,000. The incorporators are Harry C. Trexler, Allentown, Pa.; Edward M. Young, Allentown, Pa.; Daniel E. Ritter, Allentown, Pa.; Fred A. Blackwell, Spirit Lake, Idaho, and Lewis P. Larsen, Metaline, Wash.

STANDARD SPECIFICATIONS FOR PORTLAND CEMENT SIDEWALKS.

(N. A. C. U., 1909.)

The cement shall meet the requirements of the specifications for Portland cement of the American Society for Testing Materials, adopted by this Association (Specification No. 1), January, 1906.

Fine aggregate shall consist of sand, crushed stone, or gravel screenings.

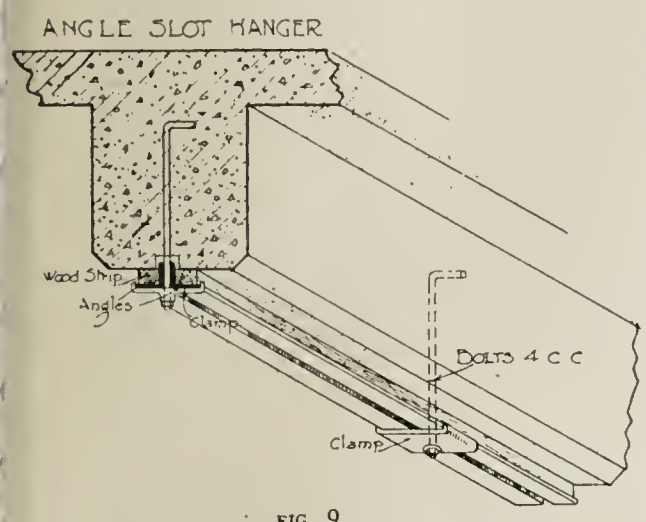


FIG. 9.

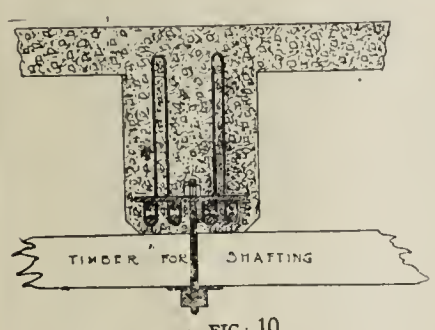


FIG. 10.

graded from fine to coarse, passing when dry a screen having ¼-in. diameter holes, shall preferably be of silicious materials, clean, coarse, free from vegetable loam or other deleterious matter, and not more than 6 per cent shall pass a sieve having 100 meshes per linear inch.

Mortars composed of one part Portland cement and three parts fine aggregate by weight when made into briquets shall show a tensile strength of at least 70 per cent of the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.

Coarse aggregate shall consist of inert material, graded in size, such as crushed stone, or gravel, which is retained on a screen having ¼-in. diameter holes shall be clean, hard, durable, and free from all deleterious materials. Aggregates containing soft, flat, or elongated particles, shall be excluded.

The maximum size of the coarse aggregate shall be such that it will not separate from the mortar in laying and will not prevent the concrete fully filling all parts of the forms. The size of the coarse aggregate shall be such as to pass a 1¼-in. ring.

Water shall be clean, free from oil, acid, strong alkalis, or vegetable matter.

Forms shall be free from warp, and of sufficient strength to resist springing out of shape. All mortar and dirt shall be removed from forms that have been previously used.

The forms shall be well staked to the established line sand grades, and their upper edges shall conform with finished grade of the walk, which shall have sufficient rise from the curb to provide proper drainage; but this rise shall not exceed three-eighths (⅜) of an inch per foot, except where such rise shall parallel the length of the walk.

Forms shall be thoroughly wetted before any material is deposited against them.

Slabs shall not contain more than 36 square feet or have any dimension greater than six (6) feet, except as hereinafter provided.

Where a greater slab area is desired, a maximum area of 625 square feet is allowed when the slab is reinforced with ¼-in. bars in both directions, at least every nine (9) inches, or their equivalent.

The minimum thickness of slabs shall not be less than four (4) inches.

The sub-base shall be thoroughly rammed, and all soft spots removed and replaced by some suitable hard material.

When a fill exceeding one foot in thickness is required, it shall be thoroughly compacted by flooding and tamping in layers of not exceeding six (6) inches in thickness, and shall have a slope of not less than one to one and a half.

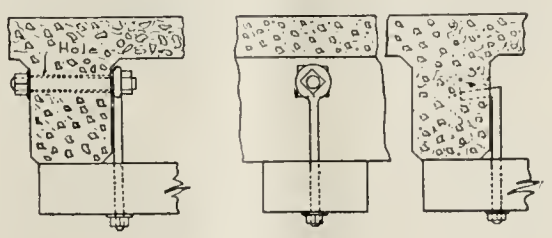


FIG. 11

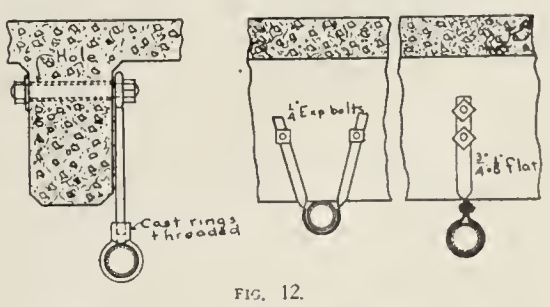
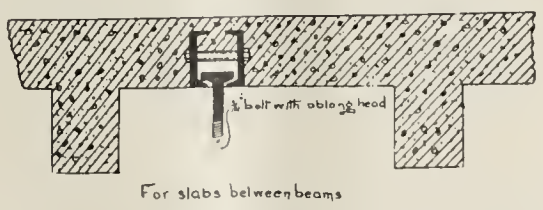


FIG. 12.



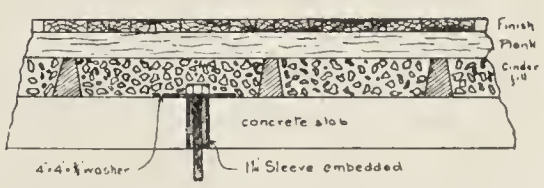


FIG. 13—METHODS USED FOR SLABS BETWEEN BEAMS.

The top of all fills shall extend at least twelve (12) inches beyond the sidewalk.

While compacting, the sub-base shall be thoroughly wetted and shall be maintained in that condition until the concrete is deposited.

The concrete for the base shall be so proportioned that the cement shall overfill the voids* in the fine aggregate by at least five (5) per cent, and the mortar shall overfill the voids in the coarse aggregate by at least ten (10) per cent. The proportions shall not exceed one (1) part of cement to eight (8) parts of the fine and coarse aggregates.

When the voids are not determined, the concrete shall have the proportions of one (1) part cement, three (3) parts fine aggregates and five (5) parts coarse aggregates. A sack of cement (94 pounds) shall be considered to have a volume of one (1) cubic foot.

The ingredients of concrete shall be thoroughly mixed to the desired consistency, and the mixing shall continue until the cement is uniformly distributed and the mass is uniform in color and homogeneous.

(a) Measuring Proportions. Methods of measurement of the amounts of the various ingredients, including the water, shall be used, which will secure separate uniform measurements at all times.

(b) Machine Mixing. When the conditions will permit, a machine mixer of a type which insures the proper mixing of the materials throughout the mass shall be used.

(c) Hand Mixing. When it is necessary to mix by hand, the mixing shall be on a water-tight platform and especial precautions shall be taken to turn the materials until the mass is homogeneous in appearance and color.

*To determine voids, fill a vessel with sand and let net weight of sand equal B. Fill same vessel with water and let net weight of water equal A.

$$\text{Per cent voids} = \frac{A \times 2.65 - B}{A \times 2.65} \times 100$$

This formula may also be used in determining voids in crushed stone and screenings by substituting for 2.65 the specific gravity of the stone.

The following is a more simple method for determining voids in coarse aggregate. Fill a vessel with the aggregate and let net weight equal B. Add water slowly until it just appears on the surface and weigh. Let net weight equal A. Fill same vessel with water and let net weight equal C.

$$\text{Per rent voids} = \frac{A - B}{C} \times 100$$

Use a vessel of not less than one-half (½) cubic foot capacity. The larger the vessel, the more accurate the result

(d) Consistency. The materials

shall be wet enough to produce a concrete of such a consistency that water will rise to the surface of the mass under light tamping, and, on the other hand, one that can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar.

(*e*) *Retempering.* Retempering mortar or concrete, i. e. remixing with water after it has partially set, shall not be permitted.

(*a*) *Methods.* Concrete after the addition of water to the mix shall be handled rapidly to the place of final deposit, and under no circumstances shall concrete be used that has partially set before final placing.

(*b*) *Freezing Weather.* Concrete shall not be mixed or deposited at a freezing temperature unless special precautions are taken to avoid the use of materials containing frost or covered with ice crystals, and in providing means to prevent the concrete from freezing after being placed in position and until it has thoroughly hardened.

Walks shall be laid in such a manner as to insure protection of the pavement from injury caused by change in the foundation or by contraction and expansion.

Workmen shall not be permitted to walk on freshly laid concrete, and where sand or dust collects on the base it shall be carefully removed before wearing surface is applied.

The wearing course shall have a thickness of at least one (1) inch.

Mortar for this course shall be mixed in the same manner as the mortar for the base, but in the proportion of one (1) cement to two (2) of fine aggregate, and it shall be of such consistency as will not require tamping, but will be readily floated with a straight-edge.

The wearing surface shall be spread on the base immediately after mixing, and in no case shall more than fifty (50) minutes elapse between the time that the concrete for the base is mixed and the time that the wearing is floated.

After being worked to an approximately true surface, the slab marking shall be made directly over the joints in the base with a tool which shall cut clear through to the base and completely separate the wearing courses of adjacent slabs.

Slabs shall be rounded on all surface edges to a radius of not less than one-half (1-2) inch.

When required, the surface shall be troweled smooth.

On grades exceeding five (5) per cent, the surface shall be roughened. This may be done by the use of a grooving tool, toothed roller, brush, wooden float or other suitable tool; or by working coarse sand or screenings into the surface.

Where color is used, the quantity and quality shall be such as not to impair the strength of the wearing surface.

Color shall be added in such a manner as to insure a uniform tint.

The application of neat cement to the wearing surface in order to hasten the hardening is prohibited.

Single coat work shall be composed of one (1) part of cement, two (2) parts of fine aggregate and three (3) parts of coarse aggregate, and the pavement shall conform in all other respects to the specifications for two-coat work.

The concrete shall be firmly compacted by tamping and evenly struck off and smoothed to the top of the form. Then, with a suitable tool, the coarser particles of the concrete shall be tamped to a depth which will permit of finishing the walk as under "Wearing Surface."

When completed, all walks shall be kept moist and protected from traffic and the elements for at least three days. The forms shall be removed with great care, and upon their removal the edges of the walk shall be protected in a suitable manner.

For curb, the trench shall be excavated to a depth not greater than the required bottom of the curb and a width not greater than the required width of the curb plus six (6) inches. Concrete shall be deposited at one operation and firmly tamped to within one (1) inch of the top of the forms. The wearing surface shall then be placed only where the curb is to be exposed, of the same composition as that specified for sidewalks.

Joints shall be made three-quarters of the total depth of the curb, continuous with those in the sidewalks, and in no case more than six (6) feet apart. The forms shall be removed as soon as practicable, when the surface shall be finished at one operation.

Combination curb and gutter shall be formed and finished, where required, at one operation.

W. W. Schouler, Chairman,
43 Clinton St., Newark, N. J.

REMARKABLE CONCRETE MIXING.

It is said that a record in concrete mixing was recently established at Sacramento, Cal. The building under construction was the Sacramento Hotel. On September 3, 1908, 381 cubic yards of concrete were made and placed in eight and three-fourths hours. The mixture was composed of 572 barrels of cement, 315 cubic yards of rock, 158 cubic yards of sand and 460 barrels of water. The mixture was hauled an average distance of 150 feet. The mixer was driven by a thirty-horsepower motor. Brought to the site by teams, the crushed rock and gravel were dumped into large bins, whence they were fed by a belt conveyor to a charging hopper above the mixer. The mixed concrete was dumped into a mechanical hoist and conveyed to its place on each floor where it was distributed in concrete carts by ten men.

Among the recent companies to be granted charters is the Maple Leaf Portland Cement Co., Limited. The directors of the company are H. Riley, J. E. Riley and E. C. Ironside. The share capital of the company is to be $150,000, with head office at Toronto, Canada.

The Grey and Bruce Portland Cement Co., Owen Sound, Ont., will be in operation for five or six weeks and will then close down. The machinery may be removed to St. Mary's, where the company intends to erect a new factory. The town of St. Mary's has been asked to put up a loan of $40,000 for five years at 6 per cent., to grant exemption from taxes for ten years, and to give a three-acre lot as a factory site. Electric power will be used, and a plant of 1,200 barrels capacity will likely be erected.

The ninth session of the Summer School for Artisans of the University of Wisconsin begins June 28th, continuing for six weeks. Courses are offered in steam and gas engines, electricity, machine design, mechanical drawing and allied subjects.

There are no entrance requirements, the purpose of this school being to offer practical instruction by lectures and laboratory practice to young men in the trades.

Certain advanced engineering courses are offered for those having the requisite preparation, and the general University Summer Session held during the same period allows opportunity for a wide choice in subjects of instruction.

A new feature of the coming session will be courses in Public Utilities testing and accounting, for those desiring to become familiar with the requirements of the Railroad Commission of Wisconsin, which has the administration of the Wisconsin Public Utilities Law. Information may be obtained from F. E. Turneaure, Dean, College of Engineering, University of Wisconsin, Madison, Wis.

CEMENT MANUFACTURE IN CHINA.

Vice-Consul General Willard B. Hull, writing from Canton, gives the following account of the establishment of extensive works by the Chinese government for the manufacture of building supplies:

"The new cement and brick works are located on Honam Island opposite the city of Canton and on the south branch of the Pearl river.

"The institution, which is known as the Chinese government cement works, will have a daily output of 500 barrels, each barrel weighing 375 pounds net. The cement making machinery is of German manufacture and cost approximately $131,219 gold. The buildings, which are all steel, cost $116,200 gold. The brick works, which are to be operated in connection with the cement works, cost $47,310, which includes all of the fire bricks used in the building of the kilns. Two houses have been erected for the directors at an expense of $29,150 and the engine house will cost about $8,300.

In addition to this there has been the expense of bunding along the river, which amounts to about $20,750 filling in $41,500, electric light installation $4,880, and the sum spent for cement used in construction, which runs up to nearly $29,150, making a total cost of the cement and brick works of $415,000.

The cement will be manufactured at a cost of about $1.15 a barrel, and they expect to put it on the market at $5 Mexican a barrel ($2.08 gold). This is 23 cents a barrel cheaper than the Green Island cement made in Hongkong, but if the competition becomes keen the Chinese can reduce their price considerably as they expect to be able to manufacture the cement at a lower figure than it can be manufactured in Hongkong.

The Northern Cement and Plaster Company of Grand Forks, N. D., has recently made improvements in its plant at Concrete, N. D., so that it now has a capacity of 1,000 barrels per day of cement, plaster and stucco. The plant turns out a high-grade natural cement which closely approaches Portland requirements. It also manufactures a bricklaying cement, a flax straw fiber plaster, hair plaster and stucco.

NEW PLANT FOR IOWA.

Construction of the Iowa Portland Cement Company's plant near Valley Junction, Iowa, has progressed to such a stage that it was announced yesterday that the big plant will be in operation by the last of May. The factory covers twenty-three acres of ground and will employ 400 to 500 men. Skilled workmen, with their families, already beginning to arrive from other plants owned by the same company.

At a special meeting of the Executive Committee of the Northwestern Cement Products Association called by Martin T. Roche, president, held at the Commercial Club in the city of Minneapolis, it was announced that the sixth annual convention will be held in the Twin Cities on February 28th, and continuing until March 4th. The convention will be formally opened Monday night and closing at 10 o'clock on Friday evening.

Propositions relative to a building wherein to hold the convention have been received from both cities. No definite action was taken. The announcement of the place and city will be made later.

The success of the last convention places the Northwestern Cement Products Association among the real leaders in the concrete movement. Time, money and energy will be freely spent to make the sixth annual convention memorial in the Northwest.

NOTICE is hereby given that we intend to prosecute all infringers of our patents on water-proof compound for use in rendering concrete impervious to water, viz.,

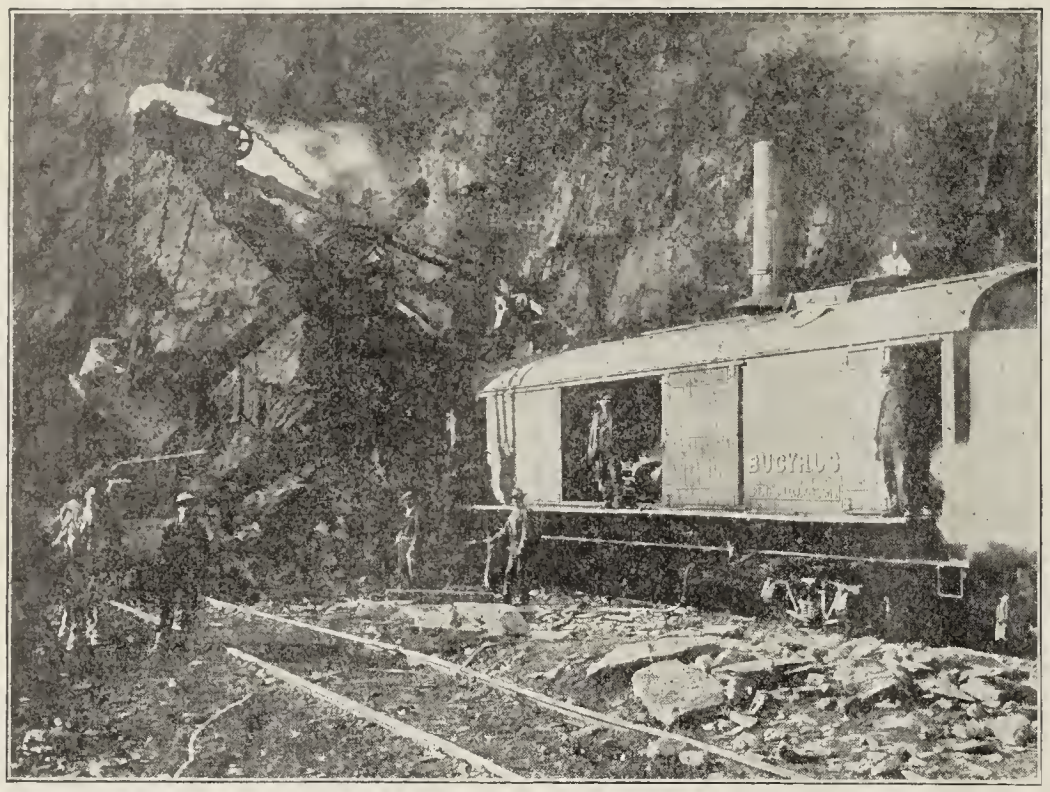
S. B. Newberry, issued April 23, 1907

H. N. Barrett, issued Sept. 15, 1908

Assignors to this Company

We have already begun suit in the United States Circuit Court of Northern District of Illinois against the Anhydrous Stone Co. and Charles W. Brown for infringement of these patents.

MEDUSA CONCRETE WATER-PROOFING CO., SANDUSKY, OHIO



95-B Bucyrus Steam Shovel in Cement Rock

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FOR

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AND

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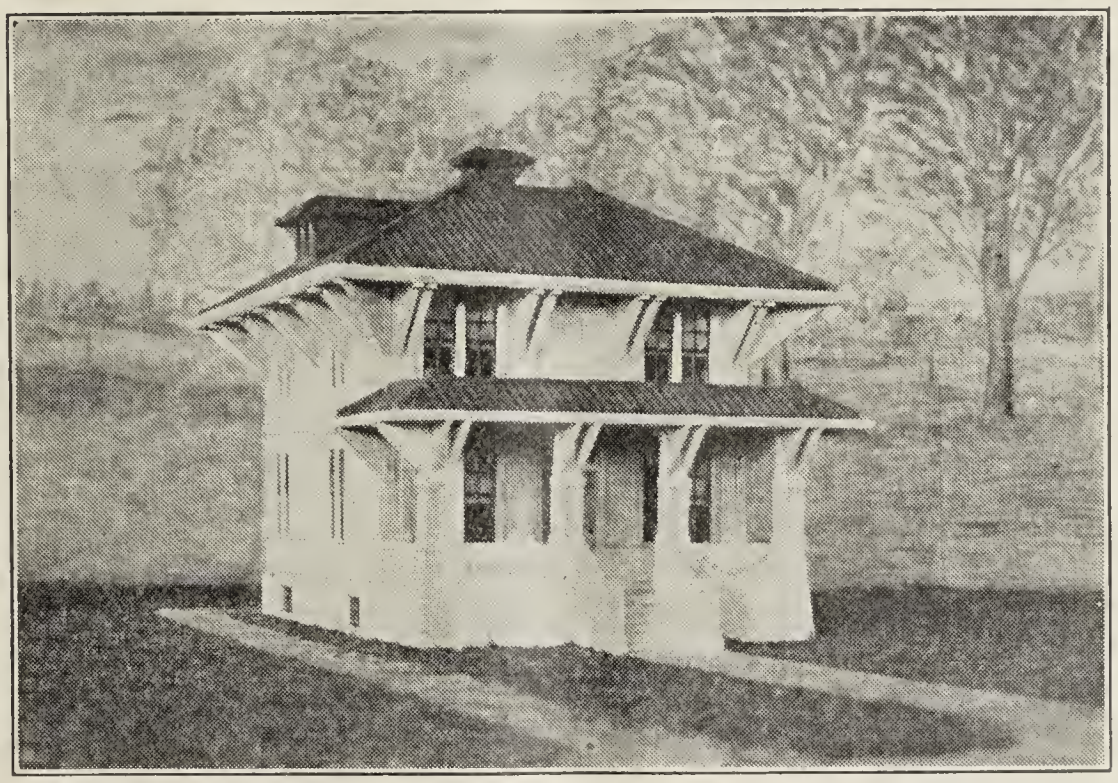
ENGINEERING NEWS

June 1909



MR. EDISON'S PET PROJECT.

Reinforced concrete house to be built in fourteen days, as it will appear when complete.

See Page 194.

CEMENT AND ENGINEERING NEWS

(PUBLISHED MONTHLY)

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JOHN F. WALDRON, Advertising Manager

CHICAGO, JUNE, 1909.

CORRESPONDENCE.

We solicit correspondence on all matters of general interest to the cement trade in all its branches. Engineering notes, public improvements, and facts and opinions drawn from practical experiments will be welcome.

LOW PRICED CEMENT BOOMS TRADE.

The sensational cry that the so-called cement trust was a combine organized to raise and maintain the selling price of Portland cement has no foundation in the light of existing facts. Cement has been laid down this season, on work in the streets of Chicago at $1.10 per barrel, and at 95 cents per barrel at certain Michigan mills, with water transportation available to all points. Present prices will not warrant heavy dividends for Michigan marl mills. Mills running on dry material are in a much better position to meet the conditions of the present low prices. The cement consumer is taking advantage of these low prices throughout the country, thus bringing about a veritable boom in cement construction. There never was so much concrete work under way as at the present time. Municipal corporations which in the past have been slow to adopt concrete construction due to local prejudice, promoted by vested interests in rival building materials, which cement construction is displacing. These municipalities are now falling in line, especially for cement sewer pipe work. Some 84 cities are now giving cement sewer pipe the preference over vitrified pipe and brick sewer construction. In the City of Denver, the question of cement sewer construction against brick and vitrified sewer pipe was debated for months by the rival interests; all sorts of objections being urged against cement sewers. To settle the question, the Citizens Improvement Association appointed a committee to investigate and report upon the relative merits of concrete and vitrified sewer pipe. This Committee after a thorough investigation, reported that concrete drain pipes, storm sewers, etc., were more efficient, sanitary, and economical than burned clay sewer materials. This committee report was unanimous in favor of concrete sewer construction; showing that wherever concrete construction is investigated upon its merits, it will win.

CEMENT PLANT FOR SPOKANE.

It is expected that work will be started immediately on the new plant of the Acme Portland Cement Company at Spokane, Wash. Mr. R. K. Neil, president of the company, has recently been in the East completing financial arrangements. The plant will be built in units, the first unit to have a capacity of 1,500 barrels a day and will give employment to about 150 men. Within two or three years it is expected the plant will be employing 450 to 500 men and manufacturing 3,000 to 5,000 barrels of cement a day.

The cement beds owned by the company are on the south end of Lake Pend Oreille. Raw material from these beds will be barged across the lake to Sandpoint and brought to Spokane on special cars owned by the cement company, unless the Coeur d'Alene electric line is extended from Hayden Lake to Pend Oreille Lake, as the Graves interests now have under consideration.

Extensive tests of the cement rock made by some of the best engineers in the United States show it to be of high quality, and the company has made careful estimates which prove that it can manufacture and sell cement considerably below the market price in this territory and can therefore practically control the field. The plant will be operated by electricity. It will be located near the city limits of Spokane, the company having options on two or three sites, one of which will be closed in the next few days.

The cement beds owned by the company cover an area of 1,700 acres. Much of them are sheer precipices above Pen Oreille Lake, and a little dynamite is all that is needed to hurl tons of the rock down to the water's edge, where it will be dumped into the dump cars.

INVESTIGATIONS OF DEPOSITS OF CEMENT MATERIALS.

A report on the results of the annual investigations of the United States Geological Survey into cement and concrete materials, which is about to be issued as an advance chapter of Bulletin 380, "Contributions to Economic Geology, 1908, Part I," covers progress in the three states of Colorado, Montana, and Pennsylvania. The possibilities of the Niobrara limestone in Colorado as a source of cement are treated by G. C. Martin; the cement material deposits near Havre, Mont., are discussed by L. V. Pepperberg; and the nature and uses of ganister in Pennsylvania are described by Charles Butts. The chapter (Bulletin 380-J) can be had free from the Director, U. S. Geological Survey, Washington, D. C.

CEMENT MATERIAL IN NORTHERN COLORADO.

The geologic formation known as the Niobrara limestone, which is composed essentially of limestone though it contains calcareous shales, outcrops in the foothills of northern Colorado. The most favorable localities for quarrying it are at points where it rises in high ridges beside low valleys, which will permit the excavations to be kept dry by natural drainage and at the same time afford a large bulk of material. Such conditions exist at various points close to a railroad. Analysis shows that the limestone is eminently suitable for cement manufacture, being low in magnesia and in some places approaching the theoretical composition of a correct cement mixture.

Another source of possible cement material in the same region is the waste of beet sugar factories, which use immense amounts of limestone in refining processes. The waste, which is entirely suitable for cement making, is at present not only worthless but costly to remove. It is increasing at the rate of about 57,000 tons a year.

LIMESTONE AND SHALE NEAR HAVRE, MONT.

Cement in the region of Havre, Mont., is especially important, as other building material is scarce. The materials, which are highly metamorphosed limestone and shale inclosed in igneous rock intrusions, will make a good cement. The deposit is local, covering only about 80 acres, but is probably sufficient to run ten kilns using 20,000 tons annually for twenty years. Sub-bituminous coal of good quality is available for fuel, but the water supply would probably have to

be piped from the Milk River. The market would probably be local.

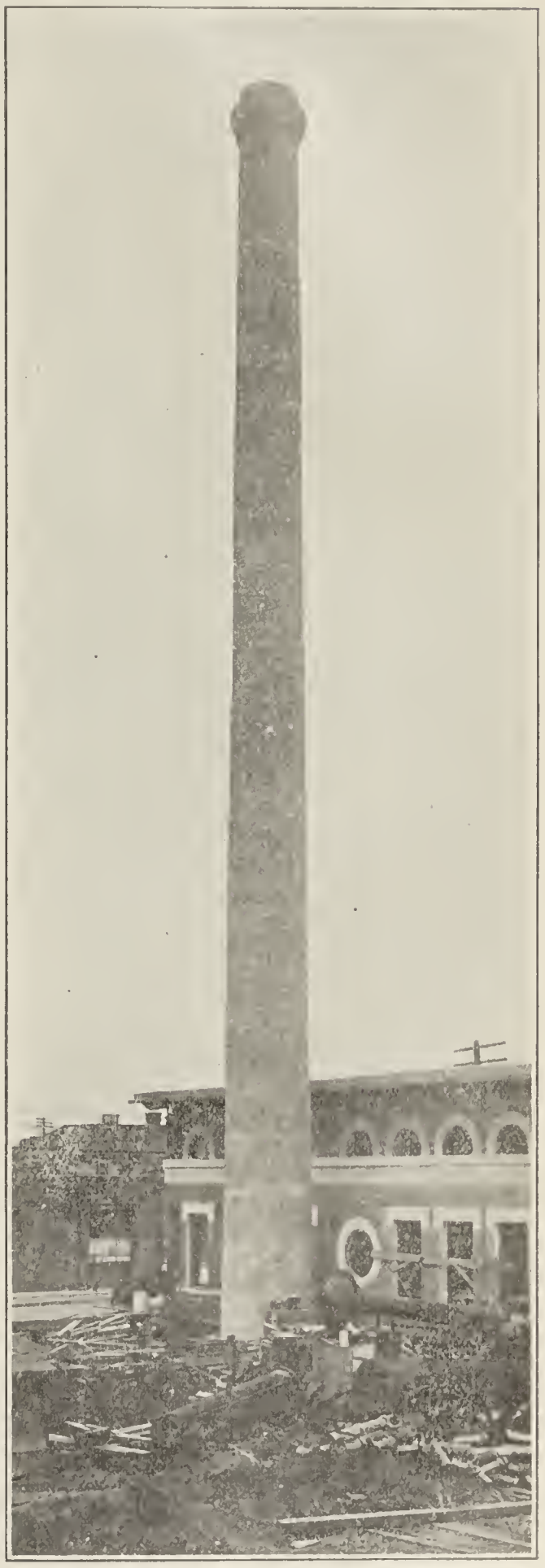
GANISTER IN BLAIR COUNTY, PA.

The ganister quarried in Blair County, Pa., is used for making refractory brick furnace linings. It occurs as a bed or beds in the formation known by geologists as the "White Medina" sandstone, which forms the crests of Tussey, Lock, Loop, Dunning, and other mountains. Practically all used at present is obtained from bowlders that mantle the mountain sides, having rolled down from the higher ridges. The supply available in this way is very great—luckily so, as the natural rock is difficult and costly to quarry.

The qualities of ganister that make it suitable for refractory brick are disputed, but seem to depend chiefly on its greater strength. It is used in furnaces that do not undergo sudden changes in temperature.

CONCRETE CHIMNEY CONSTRUCTION.

Ever since the advent of reinforced concrete as a modern building material attempts have been made to utilize it for chimney construction with more or less success. Its adaptability for this purpose has never been questioned and the only obstacle in the way of successful chimney construction heretofore has been the forms. All the engineers have agreed that the logical outline of a concrete chimney should taper from the top to the bottom not only as a matter of appearance, but for the sake of greater stability. The first concrete chimneys were built cylindrical throughout with a lining extending to the top, thus forming a double shell with an air space to protect the external concrete from the heated gases. The cost of this construction made it almost prohibitive. The next to enter the field was what is known as the off-set type, i. e., a chimney with a double shell, or lining, to about one-third the height with an off-set at this point and a single shell for the rest of the height. Instead of the weight being transmitted to the foundation in a straight line, it depends on the shear in the concrete at the off-set to carry the entire weight of the upper two-thirds of the chimney. Mr. Carl Stieler, President of the General Concrete Construction Co., Memphis, Tenn., who has spent many years in chimney construction, perfected a metal form with which it is possible at a reasonable cost to build concrete chimneys, not only tapering from the top to the bottom on the outside, but also increasing in thickness of shell as the load from the wind pressure and weight of chimney increases. This tapering design of chimney is not only pleasing in appearance, but has an increased stability over the straight type. The illustration shown herewith is reproduced from a photograph taken of the chimney built for the Birmingham Terminal Ry. Co., Birmingham, Ala. It is 4 feet 6 inches in diameter at the top and 115 feet above grade. The design of foundation is commonly known as the "spread" type, i. e., it is shallow in depth with the stresses distributed to the outer edges by reinforced bars. The concrete in the chimney is composed of one part Portland cement, two and one-half parts of sand and three parts of gravel, a mixture which makes an exceedingly dense concrete, and that can be safely relied upon to develop an ultimate crushing strength between two and three thousand pounds per square inch. The shell at the top is four inches thick and increases in thickness one-quarter of an inch for each five feet in height, making it 10 inches at the base. With the increase in area the total compression never exceeds 350 lbs. per square inch of concrete. The additional strength due to the vertical steel on the lee side where only compression exists is not considered, and this materially increases the factor of safety which exceeds 5 in the concrete alone. The stability is increased by the taper, but the heavy wall reduces the effects of the vibration to a minimum. Sufficient reinforcing steel is used to absorb all the tension that would be caused by wind pressure of 50 pounds per square foot, which is equivalent to a wind velocity of one hundred miles per hour, without stressing the steel beyond 16,000 pounds per square inch of section. The tensile strength of the concrete is not considered. The horizontal reinforcing used is a wire net placed around, and wired to the vertical bars, one inch from the outer surface of the concrete. This net consists of one-quarter-inch longitudinal steel wires spaced four inch centers, and woven together at intervals of two inches with wires. These rings not only absorb the tension on the outer surface of the concrete, caused by expansion from heat, but also assist the concrete with the shear. The chimney was started with 94 three-quarter-inch round steel bars for the vertical reinforcement. The number decreased proportionately with the sectional area and the taper of the chimney which gives practically a uniform distribution of steel throughout. There are no off-sets or abrupt changes in the thickness of the shell at any point. The taper is symmetrical both externally and internally, the outside diameter decreasing one and one-half inches and the inside diameter one inch in each five feet of height. To compensate for the reduction of the concrete at the flue opening, the sectional area is increased by a gradual swelling of the shell on the inside beginning about five feet below the opening and extending the same distance above and on each side of it. The lining is composed of a hard shale brick built without taper to about one-third of the height of the chimney, making a large air space at



the bottom which decreases to one-half an inch at the top, where it is covered with a concrete cap, built independent of the chimney to permit free expansion. The air space having no connection either with the outside air or the interior of the chimney, is without circulation and as it decreases in size permits the gradual heating of the chimney shell to the point where the lining ceases and the chimney gases come in contact with the concrete, eliminating any sudden changes in temperature. Great care was exercised in the selection of the materials and they were carefully tested before using. The concrete is thoroughly mixed and sufficient water used to give it to the consistency of a thin paste. Before fresh concrete is added to that deposited on the previous day, the surface is scraped, brushed clean, and covered with a pure cement grout, bonding the two sections together. The vertical bars are held accurately and rigidly in place by an adjustable template a short distance above the forms. The forms are built entirely of steel. The outer and inner frames are solid rings of heavy channels, making them absolutely rigid. The lining is heavy sheet iron, which insures a perfectly smooth and uniform surface on the concrete. These forms are adjustable and are accurately set to give the gradual taper to the chimney and shell. While this was the first chimney built according to this system, it was a complete success. After the foundation was completed work progressed at the rate of five feet a day. The design of this chimney is the most perfect of any concrete chimney on the market at the present time, both from a theoretical and practical standpoint, and has been approved by some of the most prominent engineers in the country. The company has a very interesting booklet on the subject of concrete chimneys.

HIGHWAY CONSTRUCTION.

The Pennsylvania legislature has voted to appropriate $5,000,000 to construct a great highway from Philadelphia to Pittsburg, right across the center of the state. If the project is carried out it will be in line with the good roads movement that is gaining so much strength all over the country.

For other states, Illinois, for instance, have had the same sort of a proposition presented to them. The argument for road building rests on substantial foundation.

It is easy to show the economic loss sustained by people living in the rural regions by reason of inability to get their produce to market in some seasons, owing to the wretchedness of the roads.

There is no longer the need once felt for means of long distance communication. That was one of the impelling reasons for the construction of the famous Cumberland road.

Under various names, "national road," "national pike," and the like, it was planned to run from the Atlantic seaboard to St. Louis. When members of congress had to ride hundreds of miles to the seat of government it was easy to be enthusiastic for the road.

The great Roman roads were recalled by the orators. The need of military highways was emphasized during the war of 1812. The westward movement of population after that war increased the demand.

The arguments for roadbuilding were counted strong enough to lead to the outlay of many hundred thousands of dollars. The advent of the railways checked it all.

Now there is a revival of interest. To get to the railway stations is important. And travel along the highways is increasing by reason of the general use of the automobile.

City people see in it a machine for pleasure riding. Country people find it increasingly useful in the ordinary routine of life. Whenever any statistics are assembled to show the use of automobiles on farms or in smaller towns the results are surprising.

The long trips that are being taken more and more are having their influence. It has been proved the automobile can be used to advantage, notably for pleasure tours, even over hundreds of miles.

But every account of a tour is marked by the complaints of the wretched condition of the highways. Even the westward walk of Weston, the pedestrian, is calling fresh attention to the backwardness of the Americans where roads are concerned.

And so, in many ways, interest in better highways is being stimulated. Legislatures are taking the matter up and there is little doubt that an era of road building on extensive scale is at hand. The old time idea of radiating roads from Washington, one running to Detroit, another to New Orleans, and a third straight away toward the central west, may yet find realization in modified form. Even those who do not live along the line of such highways are not backward in declaring for them as most important factors in the development of the country, economically, socially, and from the narrower view point of the pleasure seeker.

COST OF BUILDING BRIDGE OF REINFORCED CONCRETE.

J. R. Heddle, assistant city engineer, Hamilton, Ont., contributes some figures of cost gained from his experience in supervising the erection of a small reinforced concrete bridge in his city.

The bridge consists of two 9-foot spans, with rectangular center pier and wing-wall abutments. The girders are paneled and carry paneled solid railings. The structure contains 164 cubic yards of concrete. It replaced a wooden bridge, the old piles of which were retained and used for the new foundations. Difficulty was encountered in getting the foundation laid, owing to high water; under normal conditions the reduction in cost of this item would have considerably lowered the cost per cubic yards as given below. A 1:3:5 concrete was used, with cement costing $1.63¾ per barrels, and gravel and sand costing $1.85 each per cubic yard. Lumber cost $25.85 per M. feet, B. M., and 8,000-foot B. M. were used. The steel cost 0.275 cents per pound and 6,600 pounds were used. Wages were 20 cents per hour, and none but common labor was employed. The cost of construction was as follows:

Material.	Total.	Per cu. yd.
Sand and gravel	$ 54.30	$ 0.331
Cement	431.00	2.627
Lumber and tools	195.85	1.194
Nails	12.06	0.074
Iron and steel work	177.71	1.083
Total materials	$ 870.92	$ 5,310
Supplies:		
Gasoline and stoves	$ 15.26	$ 0.094
Rubber boots	18.95	0.115
Use of roller on approaches	18.00	0.109
Total supplies	$ 52.21	$ 0.318
Labor	1,101.31	6.710
Grand total	$2,024.44	$12.335

The item of labor includes setting up forms, filling of approaches and all labor in connection with laying concrete.

CEMENT BRICK COMPANY.

The new plant of the Universal Brick Company at Utica, Ill., is nearing completion, and will be producing brick in about thirty days. The product will be known as Universal Granite Brick, and will be manufactured from cement and sand. The plant is modern in every way, and is equipped throughout with the latest improved machinery. The cement used is manufactured on the ground, and an apparently inexhaustible supply of very excellent sand is on the company's property. Some bricks made for experimental purposes have

nown most satisfactory results in ie tests for strength, absorption, c., and the indications are very faorable for the production of a suerior quality of building brick. One dvantage of this product is the fact iat it can be made any color desired. he large capacity of the plant, toether with exceptional shipping falities, will enable the company to uarantee prompt deliveries in large uantities.

THE FIREPROOFING VALUE OF CONCRETE.

"In considering the value of conete as a material for fireproof conruction, it is well to remember just hat the ingredients of this material re and how they are put together," ays Mr. M. C. Tuttle, secretary of ie Aberthaw Construction Co., of oston, in a recent discussion of the ubject. "Well-made concrete," he oes on to say, "consists of crushed tone or gravel, sand and Portland ement. Each particle of sand is oated with cement, and each piece f stone in the concrete is coated ith mortar, so that in well-made oncrete any piece which is taken ut will be found coated nearly uniormally with gray mortar. In the est concrete, the stones are graded n size, and naturally under the tampng and handling the smaller stones ift in between the larger ones and orm a compact mass. The spaces etween these are practically filled ith the mortar.

"The effect of fire upon different inds of stone varies greatly, and acordingly the effect of heat on conrete made of different kinds of stone ill vary considerably; but it is to be oted that instead of being exposed irectly to the heat, each stone is rotected by at least a film of mortar, nd this mortar is much less affected y heat than stone of almost any ind. If a block of concrete is put n a fire and heated red hot, then aken out, it will be found that the hole mass instead of being hard as hen it went in, has become softend, and that it will crumble under a evere blow. But it will also be noced that the general shape of the lock is much the same as when it ent in to the fire. Pieces have not ropped away from the outside, but n general the whole mass has kept ogether. Single pieces of stone on he surface may be found disinterated but in through the mass the eat has apparently come so graduly that if the mass is broken in wo, the stone will generally come out s they went in, and each piece of tone will be coated with mortar. hat is, the fire has softened and injured the whole mass, but it has not caused it to explode or crumble away into dust; and this speaks of a fire that will heat the entire concrete mass red—a fire much hotter than is likely to be experienced in a conflagration. If the surface of the concrete had been exposed to a similar heat for a short enough time so the interior of the mass did not get very hot, it would be found that the surface would crumble for a little way and that beyond that as the heat decreased the concrete would show considerable strength. A test of a block of concrete with a flame will show that considerable heat has to be applied for a long time in order to affect anything but the outer surface.

"This is the general experience with concrete floors in fires. The under side usually shows somewhat crumbled,—seldom for more than an inch or so. Beyond this crumbled portion, the concrete shows its original strength and unchanged appearance. This leads to the consideration of the proper design for concrete floors. The strength of reinforced concrete construction depends upon the compression of the concrete in the upper part of the floor and the tension taken up by the steel in the lower part. It is necessary, accordingly, to protect this steel by concrete enough so that the whole floor can be exposed to a fire, the lower part of the concrete can be crumbled and the steel still remain unheated and embedded in concrete which retains its original figured strength. It would be absurd to claim that steel embedded in concrete which had been softened by the action of fire was doing the work which it was figured to do; and it is obvious that the steel heated beyond a certain point would begin to give and the floor to settle."

In conclusion, Mr. Tuttle summarizes the facts in the statement that "the whole proposition comes down to the willingness to build the structure properly; and to do this, it is necessary to have the advice of a thoroughly honest and experienced designer, and to give him leeway enough on the price so that he may design for emergencies, and not simply design a non-combustible building capable of carrying certain loads provided a common contingency such as fire does not arise."

The Searcy Concrete Block and Paving Company of Searcy, Ark., has been incorporated with a capital stock of $10,000 and will establish a plant for the manufacture of concrete blocks. T. W. Holston is secretary of the company.

MEXICAN MONUMENT FOUNDATION.

The foundation for an imposing Monument of Independence now under construction in the city of Mexico, was laid under decidedly adverse conditions and reflects much credit on the engineers in charge. The chief feature of the monument is a column of great size which will rise to a height of 130 feet. The base of the monument will be three hundred feet in circumference and under it, because of the unusually poor soil, it was found necessary to construct an unusually heavily reinforced raft foundation.

The soil underlying the city of Mexico offers serious problems to builders since it consists of very soft mud and clay. Everywhere deep, this reaches to a depth of more than two hundred feet in the central portion of the city, where the largest buildings are located. In constructing the Mutual Life Insurance Company's building there a few years ago, rock was found only after boring to a depth of 790 feet and much the same conditions were found to exist at the site of the monument. In places piles were easily pushed into place, while others, located nearby, were driven with the greatest difficulty. Such conditions suggested grave danger from unequal settlement, in consequence of which the spread footing of heavily reinforced concrete was decided upon.

The necessary excavation completed, 12,000 twenty-five foot cypress piles were driven. These were capped with a layer of concrete, reinforced with steel cup bars, which extended over the entire foundation. This was followed with a second like layer of concrete, the reinforcing cup bars in which were laid diagonally to those of the first layer. A third layer of the same kind completed the rather remarkable foundation. More than four hundred tons of steel were employed in reinforcing the three layers of concrete.

TEXAS TRADE BUILDING UP.

A notable increase in activity in the building trades and industrial lines is reported from all parts of Texas. Many important improvements are undar way and are being planned in various towns and localities.

The movement for more extensive and modern hotel accommodations in the towns and cities of the state is producing good results. In San Antonio a new hotel is being erected at a cost of $1,000,000. A syndicate is arranging to erect a new hotel at Corpus Christi at a cost of $500,000. A number of other smaller hotels are

to be erected during the summer in different towns of the state.

The San Benito Land and Water Company is preparing to install a complete and modern system of water works in the town of San Benito, which is one of the new and growing places in the lower valley of the Rio Grande. C. H. Benico of Brownwood, Texas, who owns a string of cottonseed oil mills in that part of Texas is arranging to erect a new oil mill at San Antonio at a cost of $150,000. A new electric light plant is being installed at Trinity by A. R. MacDonald. The power house is now under construction.

A syndicate of Americans who own zinc mines in Mexico have taken the preliminary steps to erect a large zinc smelter at Laredo. The recent discovery of an abundant supply of natural gas within sixteen miles of Laredo has attracted attention of the feasibility of using the fuel in the smelting of zinc ores and in other manufacturing enterprises. The city of Laredo has granted a franchise to the owners of the gas wells to pipe the product through the streets of that city. It will be used for domestic lighting and fuel purposes.

The American Rio Grande Land and Irrigation Company, in which B. F. Yoakum of New York, chairman of the Rock Island-Frisco executive committees, and a number of St. Louis men are largely interested, is doubling the capacity of its pumping plant for its irrigation system at Mercedes, in the lower valley of the Rio Grande.

The improvement will cost about $50,000. The main canal of this company was recently finished to a point twelve miles north of the intake in the Rio Grande. The canal has six and one-half miles of trunk canals and about seventy miles of laterals. The system is capable of irrigating 20,000 acres of land.

The company has expended approximately $2,000,000 in the construction of the irrigation works up to this time. It will require the expenditure of another $2,000,000 to fulfill the plans that have been adopted. The present pumps are operated by electricity. The new pumps that are being installed will be operated by steam.

MEXICAN CEMENT PLANTS.

"There are at present three cement manufacturing plants in the Mexican Republic," writes Consul General A. L. M. Gottschalk of Mexico City. "One is that owned and controlled by the Compania Bancaria de Obras y Bienes Raices, situated at Dublin, State of Hidalgo, and only a short distance from this city. A much smaller plant is that of Arenzana & Co., on the outskirts of the capital city. The third is the Monterey Steel & Iron Company, of Monterey, State of Nuevo Leon, which sells some of its product in this city. The Dublin plant turns out an excellent cement of the Portland type, which is said by persons competent to judge to be quite the equal of the imported article. It has a capacity of some 1,000 barrels per month, but expensive and radical enlargements are under way there which will bring the factory's output, or at least its working capacity, up to 1,000 barrels per day. The so-called 'Forsythe' process, which is in general use in the United States for softening limestone where limestone is used in cement manufacture, will be in operation there."

RICKETSON'S MINERAL COLORS.

Our readers attention is called to the advertisement in this issue of the Ricketson Mineral Paint Works of Milwaukee, Wis., manufacturers of high grade mortar colors and dry ore paints. These mineral colors are absolutely reliable and withstand the ravages of time, retaining their bright and fresh appearance for years and they do not fade or run. Just the thing for coloring concrete work.

The Concrete & Burial Vault Co., Borough of Queens, New York, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of engaging in the manufacture of concrete of all kinds, etc. B. Husler, Evergreen; A. A. R. Berger, and others, Brooklyn, N. Y., incorporators.

Messrs E. C. Trexler, E. M. Young, D. Ridder and A. E. Baer, of the Lehigh Portland Cement Co., have spent two weeks during the early part of May at Spokane, Wash.

The Standard Portland Cement Co., of Leeds, Ala., expect to be producing 1,500 barrels per day by July 1st of the present year.

A Portland Cement Plant is to be erected in the Arbuckle Mountains near Admore, Chickasaw county, Oklahoma. The promotors are E. S. Ayers of Edgerton, Kansas; W. D. Fry and Oscar Owens of Olathe, Kansas; L. J. Middleton and C. R. Goodale of Collinsville, Oklahoma, and Philip Lawrence of Buton, S. Dakota.

The Atlantic and Gulf Portland Cement Co. plant now under construction at Ragland, Saint Clair county, Alabama, is to have a capacity of 2,000 barrels per day. J. S. Herbert, chief engineer and general superintendent is on the ground. Excavations were commenced in March. The plant will be located on the Seaboard Air Line Ry. ½ mile south of Depot at Ragland and is to be completed by January, 1910. The cement materials will be lime stone and clay.

The Miracle Cement Block & Brick Co., Muskogee, Okla., has been incorporated with a capital stock of $20,000 by W. H. Shepherd, president and manager, J. T. Wysong, C. T. Trew, and others.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM	APRIL				TEN MONTHS ENDING APRIL			
	1908		1909		1908		1909	
	Quantity in lbs.	Value in Dollars.	Quantity in lbs.	Value in Dollars.	Quantity in lbs.	Value in Dollars.	Quantity in lbs.	Value in Dollars.
United Kingdom . .	6,800	$195	. . . .	. . . .	169,065,755	$629,523	22,216,526	$72,495
Belgium	9,749,420	30,597	802,800	$1,681	142,164,152	452,210	49,305,535	164,587
France	922,600	3,184	958,300	3,833	11,105,927	42,603	16,829,391	68,302
Germany	3,210,280	10,721	1,380,094	5,038	207,948,099	687,565	70,673,456	261,145
All Other Europe .	. . . .	. . . .	. . . .	. . . .	3,891,128	13,465	510,935	1,542
British North Am. .	800	4	1,577,920	7,783	276,540	1,628	14,823,370	75,453
Other Countries . .	1,000	25	20,000	118	5,706,947	30,080	819,347	3,416
TOTAL	13,890,900	44,726	4,739,114	18,453	540,158,548	1,857,074	175,178,560	646,939
Domestic Exports of Cement, bbls. . . .	66,836	101,963	66,778	88,304	777,415	1,214,077	646,071	902,211

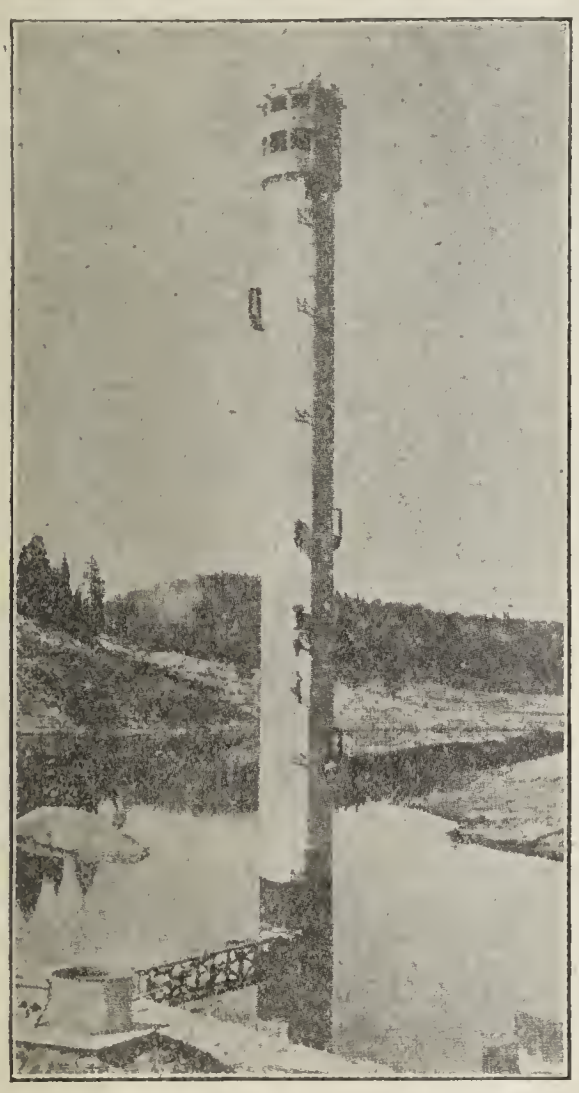
There were 22,286,736 lbs. of imported Roman and Portland Cement, etc., in the United States bonded warehouses in April, 1908, valued at $85,592, against 9,236,433 lbs. in April, 1909, valued at $20,910.

For ten months ending in April, 1908, there were 107,479 tons of asphaltum imported in the United States valued at $419,069, against 106,946 tons imported in ten months ending April, 1909, valued at $523,745.

A UNIQUE WATER TOWER, OF REINFORCED CONCRETE.

An interesting and unique construction was completed recently in Little Bear Valley, San Bernardino County, California, by Arthur S. Bent, a contractor of Los Angeles. This structure is a reinforced concrete tower, 185 feet high, 13 feet outside diameter with an inside diameter of 9 ft. to the 124 foot level, at which point it is enlarged to 10 feet 6 ins. thus giving a shell thickness of 2 feet and 1 foot 3 inches. The tower is topped with an ornamental two-story superstructure carrying the valve-stands and winch mechanism for raising and lowering valves and screens.

The tower stands in the 880-acre reservoir of the Arrowhead Reservoir and Power Company, in the San Bernardino mountains, at an altitude of 6,000 feet and is connected with the portal of tunnel No. 1, which is the outlet of the reservoir.



It is therefore an outlet water tower, designed to control the water supply of the completed system which is to lead through a series of tunnels and conduits to the valley below.

There are ten balanced 20-inch valves on the inside of the tower, each weighing about a ton; 3 of them sluice valves at the bottom of one level, and the other seven being spaced spirally at intervals of 20 feet up the tower. These valves are each fastened by 20 bronze stud bolts to a 22-in. cast-iron nipple which passes through the wall of the tower, and are controlled from the first floor of the superstructure by means of steel rods 1¼ inch in diameter, covered with brass tubing.

On the outside of the tower, elbows of cast iron are bolted to the nipples and on each elbow rests an iron screen 6 feet high and 3 feet in diameter, composed of vertical bars. These screens are raised and lowered by means of winch and chain operated from the second floor of the superstructure. The connections between the fittings are made water-tight by the use of white lead and corrugated copper gaskets. If a screen becomes choked with debris, the operator at the top closes that valve, relieving the water pressure, raises the screen, to the surface of the water, removes the debris, reseats the screen and opens the valve again. This process suggests the necessity which resulted in the devising of this tower.

It had been planned to control the water by a gate in the tunnel operated through a shaft, a grizzly screen over the portal being provided to keep out debris. But as the water rose in .the lake the increasing pressure made it difficult and finally impossible to keep the screen clear and because of this and the advantage of being able to let in any stratum of water desired for domestic use, a tower was suggested.

When the lake is filled with water it will stand about 100 feet deep around the tower. To withstand this pressure at the bottom, special attention was paid the grading and cleanness of the aggregate, the sand being thoroughly washed and freed of mica and loam and the crushed stone being carefully selected. A very dense mixture was secured. In addition to this, the lower 30 feet of the tower was given a coat of 1-inch mortar trowelled to a smooth finish and upon this a coat of waterproof paint.

To secure a smooth and impervious face on the outside a steel form was used and great care was taken in tamping and spading. This form was raised by means of four 1-ton differential pulleys, which were fastened to channel iron heads supported by a scaffold carried up on the inside of the tower. This scaffold was kept 30 feet in advance of the concrete and was built with 6 x 6 posts and 2 x 6 ledgers to carry the heavy valves and fittings as they were hoisted into place. Not being able to make a continuous run of concrete, great care was taken to prevent percolation between joints of old and new work, the surface of the old concrete being roughed up with picks and a groove 2 inches deep by 3 inches wide made. Upon this was placed a mortar composed of 1 part cement to 2 of sand before the regular mixture was placed.

Cold, snow and windy weather were encountered, which at times made progress difficult. The thermometer sometimes registering 8 degrees above zero made recourse to steam necessary; to keep the concrete from freezing a steam line was carried up the inside of the tower and connected by means of a steam hose to a coil of perforated pipes upon the outside of the steel form. A canvas hood over all confined the steam and the temperature was kept at 60 to 70 on the coldest nights. The design of the superstructure necessitated the cutting and fitting of 2,800 pieces of lumber to measure. The first floor of the superstructure projected beyond the cylinder of the tower 14 inches by 14 inches thick and acted as a cantilever, carrying the entire weight of the second floor and roof upon the projection by means of ten columns spaced equal distances apart.

The foundation block, 30 feet square and 6½ feet thick is heavily reinforced with 1-in. twisted steel and rests upon a solid rock bed. Upon this foundation block are two blocks, each 4 inches thick and of smaller size, one irregular in shape and one circular. Reinforcement of tower cylinder is deeply imbedded in these three blocks, making a very rigid structure, that when completed was found to sway but 1 inch in a high wind; and so accurately was the work carried up that when completed there was found to be at the top a variation from true vertical of less than ¼ inch.

This interesting structure is claimed to be the tallest concrete water tower in the world. It is certainly the

highest. The engineers were F. C. Finkle, F. E. Trask and W. H. Brown, Mr. Geo. Smith of Los Angeles was superintendent in charge of construction.

MILL B OF THE PACIFIC PORTLAND CEMENT COMPANY, CON., NEAR SUISUN, CAL.

Mill B of the Pacific Portland Cement Co., Con., illustrated herewith has a rated capacity of 2,500 bbls. per day and is so designed that any enlargement necessary to supply the market can be made by the addition of more kilns and grinding machinery and the extension to the present buildings.

All the buildings of the plant are the mill-type steel construction with corrugated-iron roof and sides. Where partitions are found necessary they are either hollow concrete blocks or corrugated iron. All bins, elevating and conveyor casings and machinery supports are of steel, making the entire plant fireproof.

The cement is made from two raw materials, limestone rock and clay. The rock is crushed in the quarry and dried and ground in the ball mills before mixing with the clay. Ball mills and tube mills are used for grinding both the raw materials and clinker. Rotary dryers and kilns, both using oil for fuel, are utilized for drying and burning.

Conveying Machinery.—Screw conveyors and bucket elevators, supplied by H. W. Caldwell & Sons, are installed for conveying both raw materials and clinker after being reduced by the ball mills. The conveying system in both the raw and clinker department is in duplicate, one on either side of each department. Both systems are used ordinarily, each handling half the output; but either is of sufficient capacity to handle the entire output if necessary. Belt conveyors, are used for handling the rock and clay before drying and 18 x 24 in. Peck bucket carriers, furnished by the Link Belt Co., of Chicago, are provided for handling the rock and clay after drying; also the clinkers from the coolers.

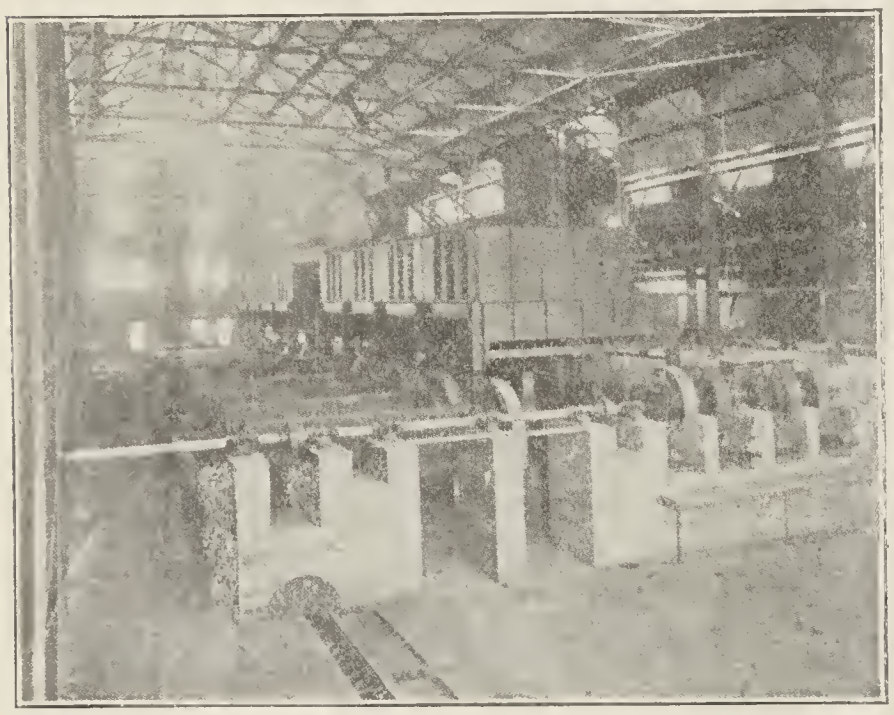
Quarry.—The quarry is located about one mile from the mill and contains an unlimited quantity of travertine rock which has been subjected to an upheaval since deposition and is very pure carbonate, which has been deposited from water carrying it in solution. The rock outcrops over a large area, with practically no soil covering it. The composition is very uniform, as shown by the following percentage analysis: SiO_2, 1.25; Fe_2C_3 and Al_2O_3, 1.00; CaO, 53.65; MgO, .55; ignition loss, 43.40.

The clay used is an aluminated buff to gray, which is soft and plastic and fuses at a moderate heat. It is free from quartz and contains no perceptible grit. The beds have been elevated and are somewhat crumbled. In the present workings the strata stand vertically and there is no stripping, as the clay extends to the grass roots. The clay is late tertiary age, an average percentage analysis of it being as follows: SiO_2, 58.25; Al_2O_3 18.56; Fe_2O_3, 7.35; CaO_2, .85; MgO, 2.10; alkali, 2.29; ignition loss, 8.55.

An average percentage analysis of cements produced from these raw materials is as follows: SiO_2, 22.25; Al_2O_3, 7.65; Fe_2O 3.35 CaO, 62.38; MgO, 1.46; So_3, 1.19; ignition loss, 1.02.

The rock at the quarry is loaded on low iron flat cars the body of which is not over 10 in. above the ground. The tracks are laid on a slight grade and the loaded cars coast to the crushing plant, which is about 400 ft. from the south end of the quarry. Two electric mining-type locomotives, each equipped with a 10-h.-p. direct-current motor, haul the empty cars from the crushing plant back to the quarry face.

Crushing Plant.—The crushing plant consists of one No. 9 and one No. 6 Gates crusher with a revolving screen 2½ ring taking the fines from the No. 9 and sending the tailings to the No. 6. The entire equipment at the crushing plant is driven by a 200-h-p. motor, and was furnished by Allis-Chalmers Co., Milwaukee, Wis. The electric railroad handling the rock from the storage bins at the crushing plant and the clay to the mill is a 36-in. gauge overhead trolley. The equipment consists of 24 steel hopper-bottom, 12-ton capacity dump cars and two locomotives each having a 50-h.-p. 550-volt, direct-current motor on each of the four axles. The grade from the quarry to the mill is 6 per cent. in favor of the loads. All cars are equipped with air brakes and the locomotives have the new E-T brake equipment, straight and automatic air.



Battery of Raw-Materials, Tube Mills. Furnished by F. L. Smidth & Co., New York City.

The clay is procured from a pit located midway between the quarry and the mill and is dug by Allis-Chalmers 40-ton steam shovel with a one-yard dipper. Seven-ten side-dump cars carry the clay from the pit to a 9-ft. dry pan by means of a single-drum hoist, equipped with 40-h.-p. variable-speed motor.

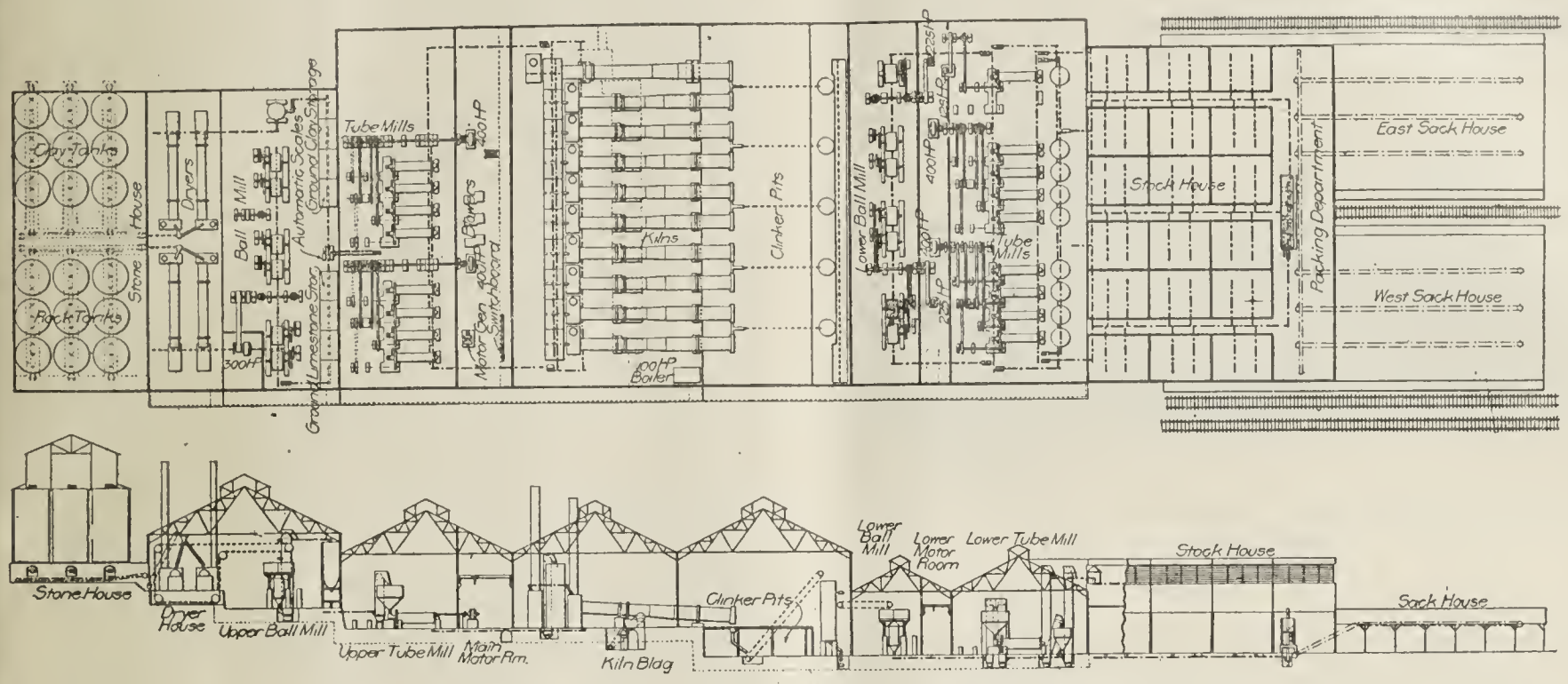
Stone House.—The stone house where the rock and clay are received consists of 18 circular steel tanks 20 ft. in diameter and 40 ft. high. Nine of these tanks, with three in a row, on the west side are for rock and the similar arrangement on the east side for clay. Trains from the clay pit and quarry running overhead dump the rock and clay direct into the tanks, which have a capacity of one week's storage of rock and about three weeks' storage of clay.

Dryers.—On the next terrace with an elevation 15 ft. below the stone house, are located the four dryers, each 50 ft. long and 5 ft. in diameter, which were manufactured by the Vulcan Iron Works. Two of these are for rock and the other two for clay. The dryers, elevators and the belt conveyors feeding the same are driven from a line shaft, power being supplied by a 40-h.-p. motor.

Rock and Clay Grinding.—From the dryers the rock is conveyed and elevated by Peck carriers to bins over six No. 8 Krupp ball mills located on the next terrace, 10 ft. below the dryer terrace. From the ball mills ground limestone passes to four storage bins of the Berquist patent type, each holding about 150 tons. The ball mills are driven by belts from two line shafts, power being furnished by a 300-h.-p. Allis-Chalmers motor operating at 514 r.p.m., which is located in a small power room at one end of the ball mill terrace. This power room also contains a switchboard from which all lights and the motors driving conveyors and elevators in stone house, dryer and ball mill room are controlled. The clay from the dryers passes by means of Peck carrier to a 9-ft. dry pan equipped with 3/16-in. mesh screens located at the east end of the ball mill terrace. From this the ground clay is conveyed to four storage bins with the same capacity and of the same type as used for ground limestone.

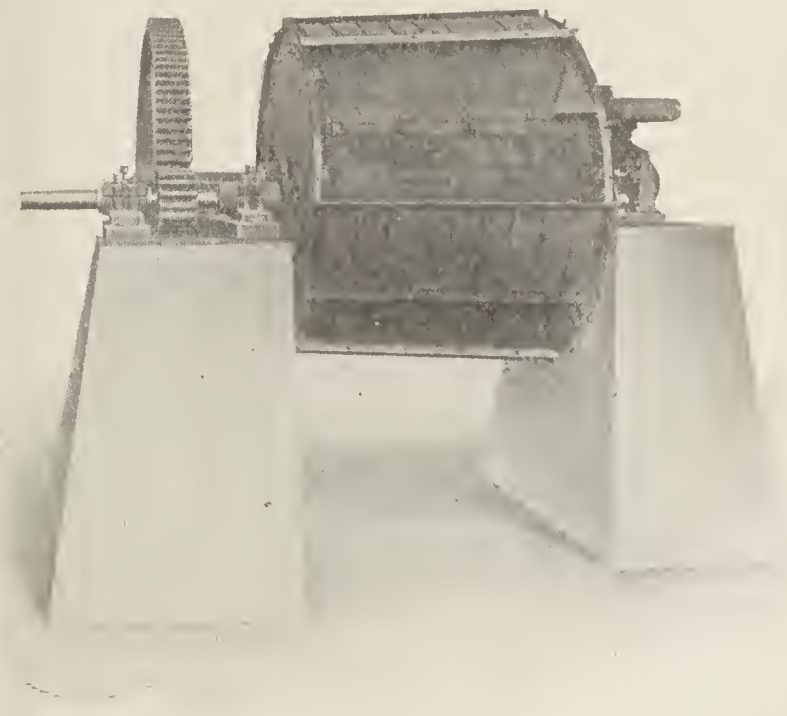
Mixing.—A 12-in. screw conveyor under the Berquist storage bins for ground limestone and clay conveys the materials forward to two sets of Richardson tandem automatic weighing machines. The two sets of machines are used ordinarily, but if anything happens to one set the other is ample to handle the output. A mixing conveyor, consisting of two 16-in. cut flight screw conveyors, running in one casing, conveys the materials to distributing conveyor over the tube mill bins.

Raw-Materials Tube Mills.—Eight No. 16 Davidsen tube mills, manufactured by the F. L. Schmidt & Co., New York City, are provided for finish grinding of raw materials. These mills are in batteries of four driven by belts from two-line shafts. The building housing the tube mills has been made large enough to accommodate two more mills if found necessary for the present output of kilns.



Plan and Sectional Elevation of Buildings of Mill B, Pacific Portland Cement Company.

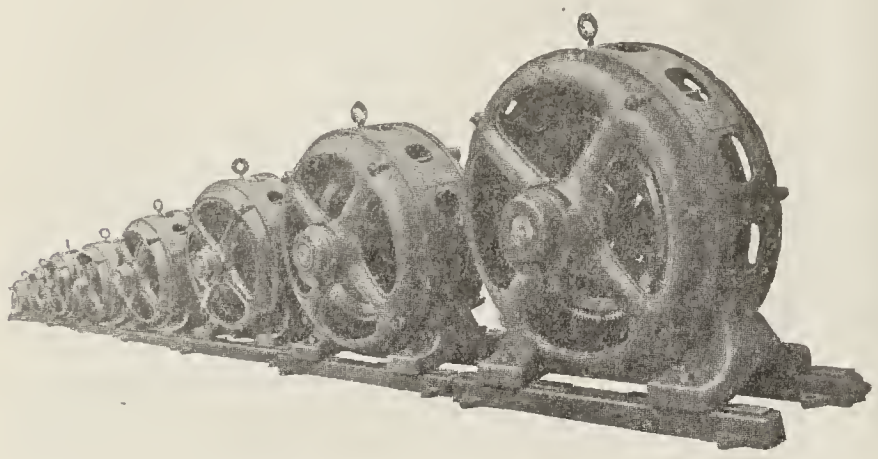
Kilns.—Separated from the tube mills by the main power house, but on the same level, is the kiln room, which contains 10 kilns, nine each, 7 x 80-ft. and one 8 x 100 ft. Each kiln is driven by a 15-h.-p. variable-speed, 440-volt motor, having a 100 per cent. speed variation. These motors are located in the tunnel under the kilns away from the heat and dust. The kilns are fed by 9-in. screw conveyors located under the kiln bins which discharge into a water-jacket feed pipe. Upright 8 x 32-ft. coolers, are provided for cooling the clinker. From these coolers the clinker passes by a Peck carrier and pan conveyor to bins over clinker ball mills.



View of Kominuters Installed in Pacific Portland Cement Mill. Furnished by F. L. Smidth & Co., New York City.

Clinker Ball Mills.—Six ball mills and one Lindhard No. 66 kominuter are provided for grinding the clinker. These machines are located at the same level and are separated from the clinker pit by a corrugated-iron partition.

Clinker Tube Mills.—Separated from the clinker ball mills by the lower power house, is a 73 x 192-ft. clinker-tube mill building, containing nine No. 16 Davidson tube mills and nine separators. Eight of these tube mills are in batteries of four, driven from two-line shafts, the same as the raw tube mills. The ninth mill is belt-driven from a line shaft, power being furnished by a 125-h.-p. motor. Foundations for ten tube mills were put in when the mill was constructed, but only nine mills



Motors in Pacific Portland Cement Mill Furnished by Allis-Chalmers Co.

were installed pending the development of the plant. Two separate conveying systems are installed in the clinker tube mill building, one for conveying the material from the mills to the separators and from the separators to the stock house, and other conveying the material from the tube mills direct to the stock house in case the separators are not running.

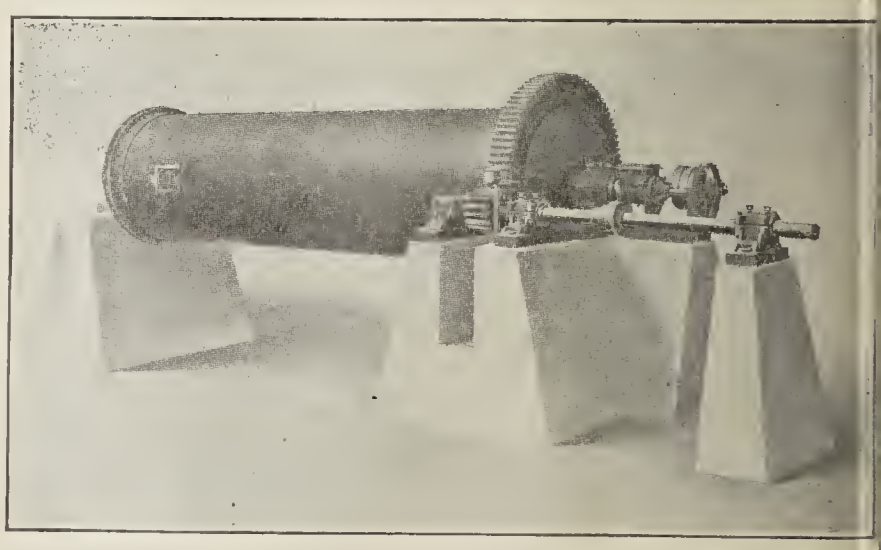
Stock House.—The stock house is a 124 x 180-ft. building, with eighteen reinforced-concrete bins each 24 x 32 ft. in plan and 22 ft. high, holding about 4,500 bbls., or a total storage of 80,000 bbls. These bins are arranged in rows of three each with an aisle between in which the conveyors and shafts driving bin conveyors are located. The packing equipment consists of five automatic weighing machines, manufactured by the Automatic Weighing Machine Company, Newark, N. J., which are set on a raised platform about 3 ft. high. In front of this platform is installed a 24-in. flat-belt conveyor, which can be run in either direction, carrying the filled sacks to either side of the stock house where the cement is trucked into cars. If the sacked cement is to go to storage houses a scraper slides the sack off the belt and deposits it on one of the six 24-in. flat-belt conveyors, which are inclined until they reach a height of about 16 ft., and then run level the full length of the storage houses.

Storage Houses.—There are two sack storage houses, each 90x112 ft. in plan, with three 24-in. flat-belt conveyors overhead to distribute the sacks. These two houses have a storage capacity of 40,000 bbls. when sacks are piled 25 high. An additional sack storage is in the course of erection which will double this capacity.

Power.—The entire equipment of the mill is electrically driven by three-phase, 60-cycle induction motors, power being supplied by the Bay Counties Power Co. from the hydro-electric development of that company on the slope of the Sierra Nevada Mountains. The power at 60,000 volts is delivered at a substation located on the Pacific Portland Cement Co., Con., property, about 1,000 feet from Mills A and B. At this point it is transformed dow to 2,080 volts and delivered at this latter voltage to switchboard in the main power house. All moto throughout the mill of 30 h.-p. capacity or above are 2 080 vots, machines all under 30 h.-p. are designed t operate at 440 volts.

Main Power House.—The main power house is locate between the raw tube-mill and the kiln buildings, bein separated by 6-in. hollow concrete-block walls. Th building is 29.5 x 192 ft. in plan, with a five-ton capacit overhead crane. In this building are two 400 h.-p. Allis Chalmers motors, operating at 192 r.p.m. and direct-con nected to the line shafts driving the raw tube mills b means of 600 h.-p. Pelton flexible couplings. Thre blowers geared to 85 h.-p. motors furnish air for th kilns; and a motor-generator set furnishes power fo the electric road from the quarry. This set consists of 580-h.-p. 2,000-volt, alternating-current motor operatin at 50 r.p.m., a 400-h.-p., 500-volt, direct-current moto The operation of the various electrical equipment in th power house and the distribution of power to the lowe power house and sub-boards in other buildings, is con trolled from a 19-panel switchboard, located at one en of the power house. This board has two panels on th west end, on which are mounted the two main switche of the Bay Counties Power Co.; also their meters an recording wattmeter. Next to these is the totalizing pan el containing the ammeters, voltmeters, and recordin wattmeter. The other 16 panels are for th different machines in the power house, for lights, and s forth. All the power wires, auto-starters, transformer and compensators connected with this board are in tunnel below extending across the power house. Thi tunnel joins into a larger tunnel running the entir length of the mill on the west side, which accommodate all power lines, telephone and light wires, water, oil steam and compressed air pipes, in addition to terra cott sewer and drain pipes.

Lower Power House.—The lower power house is lo



Eigth Davidson Tube Mills Manufactured by the F. L. Smidth & Co., New York City, Installed in This Cement Mill.

cated between the clinker ball and clinker tube mills from which it is separated by a concrete block wall. Al the electrical equipment was furnished by Allis-Chalmers Co., Milwaukee, Wis., It is provided with an over-head crane the same as in the main power house. The building is 16 x 192 ft. in plan and contains all the motors driving the ball and tube mills as follows: Two 400-h.-p. motors, direct-connected to line shafts driving the tube mills, the same as in the main power house one 125-h.-p. motor driving one tube mill, and two 225-

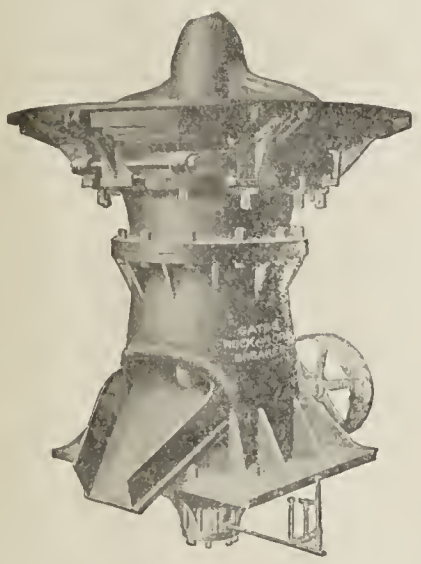
.-p. Allis-Chalmers motors belted to line shafts driving ie ball mills. The electric equipment in the lower ower house as well as lights and distribution of power clinker mills, is controlled by a nine-panel switchboard cated at the west end of the building. This board is in vo halves with two separate leads from the main power ouse.

Store Room and Machine Shop.—The machine shop, ore room, carpenter shop and belt-making room are l under one roof separated by corrugated iron partiions. The building is 52x106 ft. in plan, with wooden usses and purlins, covered sides and a roof of galanized corrugated iron. The machine shop contains nly the following small machines: A Bickford 6-in. radial drill; one 24-in. Queen City shaper, and ne Lodge & Shipley 18-in. lathe; an Acme belt cutter, power saw, a wall drill and a blacksmith's forge. All rge machine tools are in the shop at Mill A.

Fuel Oil.—The fuel oil is received by the Standard il Co.'s barges at Suisun, a small town about 6 miles rom the works, located on a slough leading into San rancisco Bay. These barges discharge into a 400,000al. storage tank at the pumping station. From this torage tank the oil is pumped through a 6-in. pipe to concrete reservoir, with a capacity of 150,000 gal., that located on sidehill back of the mill.

Railroad.—Mills A and B are about 2½ miles from ie Southern Pacific R. R. and the Pacific Portland Ceient Co., Con., operates its own road joining the Southrn Pacific at a station called Tolenas. The equipment onsists of three locomotives, one coal burner and two il burners. The line leading to Mill B terminates with hree switches to the stockhouse and one to the centre etween the sack houses. This allows 17 cars o be placed for loading without switching. A witch on the west stock house track leads to the store oom and extends along the entire west side of the vall. A two-ton stiff-legged derrick, with a doublerum electric hoist, is located below the store room for andling all heavy machine parts.

Village.—Since the new Mill B was projected the illage called Cement has been enlarged by the addition



Two No. 9 and No. 6 Gates' Crushers Installed in This Cement Mill by Allis-Chalmers Co.

of 25 cottages and commissary, and a hotel of 10 rooms, for the convenience of mill operatives. All the cottages are supplied with water, electric lights, long distance telephones and a complete sewage system.

The officers of the Pacific Portland Cement Co., Con., are: Messrs. Wakefield Baker, president; F. Drum, first vice-president; R. D. Robbins, second vice-president, and N. L. Bell, secretary. The designing and construction of Mill B were in charge of Morris Kind, general superintendent, assisted by Wm. J. Moore, in charge of the engineering department, and the writer, who was constructing engineer.

The old directors of the Edison Portland Cement Co., were re-elected at the last annual meeting in May. The yearly report was not made public.

Mr. and Mrs. Thomas Bickel are the promotors of a Keene Cement plant at Richfield, Sevier County, Utah,

View of one of the Shipments of Kominuters and Tube Mills Leaving the Shops of F. L. Smidth & Co., New York City.

the plant is being promoted on the strength of certain samples of imitation marble shown by the Bickel's.

Tidewater Portland Cement Company of Wilmington, Del., was incorporated to manufacture, sell and deal in Portland cement and all similar building or construction material. The incorporators are office representatives, and the capital stock is $4,000,000.

A committee representing the stockholders of the Alpena Portland Cement Co., has made an extensive tour of investigation and inspection of 14 Portland Cement mills in Michigan, Illinois, Iowa, Missouri, and Kansas, and one plant at Port Colburn, Canada. A detailed report of the trip will be made to the stockholders of the Alpena Company after which some action is expected to be taken in remodeling the old Alpena plant, to bring the same up-to-date.

Ex-State Senator, Elmer I. Philips, has been elected treasurer of the New Castle Portland Cement Co., to succeed Edwin F. Norris, who resigned.

A 500 barrel Portland cement plant is being promoted at Brigham, Boxelder County, Utah, Capital stock $500,000.

The New Orleans Daily Item, says that a cement plant with a capital stock of $1,000,000 is to be built 6 miles south of Evergreen, Conecuh County, Alabama by Ohio capitalists who have been purchasing land on the line of the Louisville and Nashville Ry., for the past two years. This location is 80 miles south of Montgomery.

The Marquette Cement Manufacturing Company of La Salle, Illinois, large manufacturers of Portland cement, will July 1st retire the entire balance of their bonded indebtedness, taking the funds from accumulated net earnings.

THOMAS A. EDISON'S REVISED PLANS FOR CAST CONCRETE HOUSES.

The original plans for producing cast concrete houses, devised by Thomas A. Edison have for a time at least been abandoned. The revised plans call for a dwelling 25 x 30 feet after designs by George E. Small and Henry J. Haines, the engineers engaged by Mr. Edison to work out the details of the iron molds in which the houses are to be cast. The buildings will be three stories and cellar under the whole house, the first story will contain two rooms, living room 23x14 feet, 9 feet, 6 inches high. A kitchen 20 feet, 6 in. x 14 feet, with a wide roomy stair case in one corner of the front room, leading to the second story, which will contain two large bed rooms, a wide hall and a bath room, 7 feet, 6 in. x 7 feet, 6 in. x 8 feet, 2 in. high. The third floor has two large rooms, each room has large windows. The cellar will have stationary wash tubs, boiler and coal bunkers. The cellar wall will be built in advance and be permitted to harden before the superstructure is commenced. The interior and exterior walls will be richly decorated, these decorations will be produced in the casting of the house, one of these houses if built of stone would cost $20,000 and over, while the cost concrete house including heating and plumbing will cost only $1,200, ready for occupancy. Mr. Edison's idea is to furnish sanitary homes for working people, that will rent for about $9.00 per month, plus car fare. The finish on the inside walls obtained by a special mixture used will be perfectly smooth and can be tinted or painted if desired. The cost estimate is based upon erecting at least six houses at one time, in order to keep the men fully employed and in localities where sand and gravel from excavations can be used in making the concrete. The molds to be used in the erection of a group of houses will cost about $25,000 and the working plant $15,000 more. The time required to erect the moulds will be about 4 days, and six hours to fill them with liquid concrete, after standing six days in the molds the concrete will be sufficiently hardened to permit the forms to be taken down, consuming 14 days for the construction of each dwelling. Mr. Edison figures on producing 144 houses on one year with six sets of molds. The cost for the use of the molds for each house during the first year including the cost of the working plant would be slightly less than $250 for each building erected. The same molds used over again during the second year would be less than $125.00 for each house. We are indebted to Orange Advocate for the illustration and data given.

A large concrete dam is being constructed at Nederland, near Boulder, for the Central Colorado Power Co. About 400 men will be required for this working crew. The McArthur Brothers Construction Co., of New York, has charge of the work. They have installed one of the largest mixers in the country. When working full capacity 1,000 cubic feet of concrete will be the product every 24 hours.

Aerial and surface trams have been provided and six engines and 150 cars will be used in moving material to the dam. The trench is practically completed for twelve miles of pipe line and work has begun on the concrete conduit. It will be three feet in diameter. Most of the summer will be required to perfect the work.

A new 1,600 barrel Portland cement plant is being built at El Paso, Texas, by the Southwestern Portland Cement Company. The plant is located about a mi from the city limits, on a tract of 900 acres, containin deposits of material from which the cement is to b manufactured. The plant is to be completed by Octo ber and the brand of cement will be El Toro.

The Maple Leaf Portland Cement Company of To onto, Canada, incorporated, capital $50,000. Incorpora tors, H. Riley, J. E. Riley and E. C. Ironside, Toronto

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The Muskoka Sand and Gravel Company, of To onto, Canada, incorporated to manufacture cement, cap tal, $40,000. Incorporators, W. Sandford, New York and G. A. Marchant and H. L. Dunn, Toronto.

The Ogden Portland Cement Company, of Ogden Utah, has been incorporated with a capitalization o $500,000, in 5,000 shares of $100 each, of which all ar subscribed. Willard J. Bell, of Newaygo, Mich., presi dent; Harold C. Day, Chicago, vice-president; Ralp E. Bristol, Chicago, secretary and treasurer; Alvin T Theits, of Grand Rapids, Mich., and Henry C. Baker of Ogden, additional directors. The company ha opened offices at rooms Nos. 6 and 7 in the Badco block, Ogden. The plans for the erection and equip ment of the plant, which will be located at Baker' Spur, north of Brigham, are being prepared at Newaygo Mich., under the direction of Willard J. Bell, presiden of the company, a practical cement man of extensiv experience.

The Sterling Portland Cement Company of Dela ware has been incorporated with a home capital stock of $1,800,000 and authorized to do business at Louisi ana, Mo., with $50,000 capital. This is the company which purchased land north of Louisiana, of which J R. Patterson is the president.

STANDARD PORTLAND CEMENT CO.

Acting as assignee for unfortunate creditors to th California cement combine, D. C. Norcross began sui on May 23, for $50,000 against the Standard Portland Cement Company, William J. Dingee and Irving Bach man. Norcross holds notes of $76,000, given at th time the trust bought up numerous cement plants a year ago. Of this sum $26,000 has been paid. Th notes on which the suit is based are as follows: Sidney V. Smith, $25,000; Northwestern Portland Cement Com pany, $25,000; Western Building Material Company $19,000; D. M. McKay, $3000; Catherine E. Spencer $3000; A. F. Hamilton, $1000.

The Union Portland Cement Co., of Rushsylvania Ohio, is to be foreclosed under a $50,000 mortgage held by nine Columbus, O., stockholders. This course was decided upon at the last meeting of the stock holders, held at Rushsylvania on May 21st, it as expected that the mortgage holders will bid in the plant.

A cement drain tile factory has been located at Mitchell, S. Dakota by Mess. Wayne and Hilliard. The main factory building has been finished one and one half stories high covering an area of 52 x160 feet. The floor is of concrete with three tracks for handling the material raw and finished products. The machinery will be electrically driven. The firm will make other

cement products such as cement building blocks floor and sidewalk tile, columns. 20 men will be employed at the start, all seventh day adventists, the factory will be managed by Mr. Wayne. The other partner Mr. Hilliard is a silent one. Mr. Wayne is from Spencer, Iowa.

The Denver & Northwestern Portland Cement Co., has been incorporated at Denver, Col., for $1,000,000. A plant with 1,500 barrels daily capacity will be erected at Golden. Officers are: W. S. Campbell, president; J. B. Church, vice-president; F. B. Davis, secretary; G. N. Robinson, treasurer, and H. Fleck, chemist.

Denver, Col., is the latest large American city to adopt reinforced concrete pipe for sewers. The city has investigated the sewer pipe question and has decided that it can save money by using the concrete product. Sizes from 25″ to 72″ will be used and it is expected that about 19,000 feet will be laid at once.

INCONSISTENCIES IN NEW YORK CITY'S BUILDING CODE.

The controversy over New York City's building code, at least in so far as it is outlined in the newspapers, has some curious inconsistencies and some downright absurdities.

The code is a matter of vast importance to all classes of people as relates not only to dollars, but to life. Hollow terra-cotta tile has its place and uses, but positive demonstrations of its lack of value under certain conditions, as demonstrated in the conflagration in Baltimore and San Francisco should not and must not be overlooked. Yet lawmakers take up the question as if positive evidence was lacking.

Argument is one thing, demonstrated facts another. We call your attention to Bulletin No. 324, United States Geological Survey, embracing reports on the San Francisco fire and earthquake. The reports were made by Richard L. H. Humphrey, representing the Structural Materials Division of the United States Geological Survey, and Capt. John Stephen Sewell, Corps of Engineers, U. S. A. The Bulletin is profusely illustrated by reproductions of photographs taken on the spot, illustrating the success and failure of fireproofing materials.

Both Mr. Humphrey and Capt. Sewell agree that construction in San Francisco was not of a kind to withstand either earth vibrations or fire; that generally speaking it was cheap and poor, and that in most every case where an effort was made to make a building fireproof, one or more vital protecting measures were overlooked or neglected ,thus to a great extent nullifying the good work accomplished in other directions.

The most marked lessons to be drawn from the reports were that hollow terra-cotta tile was a failure in San Francisco in floors, walls, and partitions, and as a protection to metal beams, girders and columns when attached by severe heat, and that reinforced Portland cement concrete and concrete mortars won signal triumphs. The excerpts from Mr. Humphrey's report which follow, are in few cases continuous, but were taken in such order as they appealed to the writer. Among other things Mr. Humphrey said:

"To the user of the materials of building construction the study of the behavior and relative efficiency of the various classes of such materials under the unusual and rigorous conditions imposed by the earthquake and fire is most interesting and instructive. The test was one of such violence that only structures of first-class design and materials and honest workmanship could survive. Flimsy and loosely built structures collapsed like houses of cards under the terrific wrenching and shaking, and many ofr the structures which with stood the earthquake were subjected to a second test in a fire which surpassed all the great conflagrations of recent years. Some of these structures which successfully withfailed signally under the second, by reason of inadequate fireproofing. A very fe wwithstood both tests successfully.

"While reinforced concrete structures were few in the zone of seismic disturbances, these few stood the test by earthquake and fire in a highly satisfactory manner. Rigidity and stiffness and a high fire resistance are inherent qualities of concrete, and this material proved admirably suited to resist these extraordinary tests.

"Stone and brick masonry cracked diagonally in the form of an X. Hollow title partitions and masonry of brick and stone were similarly cracked, although this injury was small where Portland cement mortar was used. Where the walls were laid with hard brick, with plenty of headers, and in Portland cement mortar, and were properly tied to the floor and roof members, there was little, if any damage.

"Brickwork suffered most from the earthquake and least from fire, and sandstone splintered less than granite, which suffered severely. Concrete proved superior to brick as a fire-proofing material.

"Concrete is probably the best fireproofing material, because, as shown by experience, its stiffness will enable it to support not only the steel within, if the latter is softened by heat, but perhaps the structure itself.

"The ten-story Aronson Building, on the corner of Third and Mission streets, had a steel skeleton with hollow-tile partitions and fireproofing for the columns. The floors were of concrete reinforced with expanded metal. Two of the columns on the first floor buckled by reason of the failure of the hollow-tile, the columns being shortened about 10 inches. Columns also buckled in the basement and on the fifth, eighth and tenth floors. In the basement two columns were fireproofed with concrete, and remain in first-class shape, but near them are two badly buckled columns which were fireproofed with terra-cotta. This result is an excellent object lesson on the merits of the two systems of fireproofing. The sandstone was badly spalled by fire, and the walls were badly racked by the earthquake. The cast-iron stairways were very much damaged. The fire in this building was not severe.

In speaking of the eleven-story Mills Building of steel skeleton construction, with hollow-tile fireproofing and hollow-tile partitions, Mr. Humphrey says:

"The walls were racked by the earthquake. The hollow-tile failed and left the steel skeleton exposed. Four of the basement columns buckled, and the lower webs of the floor tiles failed over large areas. ** Owing to the failure of the floor tile many safes fell thro' the several floors."

In speaking of the Union Trust Company's building, Mr. Humphrey says: "The hollow-tile partitions failed extensively, and the lower web of the floor tile spalled over large areas. ** The steel trusses on the tenth floor were very much distorted by heat, owing to the failure of the hollow-tile fireproofing."

Capt. Sewell, in the course of a voluminous report

covering generally the same ground as did Mr. Humphrey, says:

"There are two opposing parties in the matter of fireproofing in San Francisco—those who have favored the hollow-tile system, and those who believe in concrete as the best fireproofing material. The Bekins Van and Storage Company's warehouse the only building of considerable size in the city constructed of reinforced concrete, has already been mentioned as resisting the action of the earthquake and fire. In this building the concrete acted as a perfect fireproofing protection for the steel."

"Good Portland cement concrete has won a triumph for itself in fireproofing in San Francisco, for wherever well made and properly laid upon the steel girders or columns, it protected the metal. * * * Examination showed also that it protected well against rust. The heat to which it was subjected was very great, in places common mortar being fused and ironwork in walls melted."

"The fire in this building (the Mutual Life), while not severe, was sufficient to cause the failure of the tile fireproofing of the roof trusses, which collapsed from exposure to heat.'"

NEW INLAND PORTLAND CEMENT MILL.

Spokane, Wash.—One million dollars is the capitalization of the Inland Portland Cement company, composed of Pennsylvania and Spokane men, headed by Colonel H. C. Trexler of Allentown, Pa., where he is president of the Lehigh Portland Cement company, just organized in Spokane. The plant will be located at Metaline, Wash., on the extension of the Idaho & Washington Northern railway. A power plant with a head of more than 400 feet will be built on Sullivan creek, and ample power will be developed.

F. C. Fisk, an expert engineer of Buffalo, N. Y., who has been looking over the cement deposits in the west for a year, will remain to superintend the construction of the plant. The plant will be completed, it is expected, and manufactured cement on the market within a year.

The directors are Colonel H. C. Trexler, E. M. Young, Allentown, Pa.; Henry L. Mosser, Newberry, Pa.; F. A. Blackwell, Spirit Lake, Idaho; and Louis P. Larsen, Spokane, F. A. Blackwell, who is vice president of the local company, has gone east with Colonel Trexler and Mr. Mosser.

Cement forms a large element in the irrigation system of Colorado. At Greeley the Barnes Irrigation ditch, which feeds Lake Loveland and Boyd lake, was cemented for about 600 feet to prevent the possibility of a washout during high water. The ditch runs along an embankment for practically that distance. The time is coming in Colorado when every ditch and lateral will be cemented. At present the waste of water from seepage is enormous. When this wasted water is utilized millions of acres will be restored.

THE WEAKNESS OF GRANITE.

The popular idea of the hardness of granite is justified when the rock is put to any sort of mechanical test. Nevertheless granite is far from being so enduring a rock as is generally supposed, for if it can resist rude shocks it is vulnerable to the assaults of the chemical and physical agents of the air. The alternations of frost and heat are the chief agents in this destructive work. Heat expands and loosens the crystals, making a way for moisture, and the frost carries on the process. Even in countries which never know actual frost, as in the Egyptian hills and in Brazil, the great daily variation of cold and heat peels off the surface of granite in onion-like crusts. In towns other corrosive agents of a fouled atmosphere come into play. In fact, as a resister of the more subtle agents of destruction, this hardest of rocks is not to compare with some of the softest. As Sir Archibald Geikie puts it—"There is no necessary relation between the hardness or softness of a stone and its durability under the attacks of the weather. Granite, basalt, limestone, and many other materials are much harder than soapstone, slate, and chloritic schist, yet they decay much more rapidly. But lest the owners of well appointed family burying grounds should be rendered anxious about the perpetuation of the family records and virtues, it may be added the polishing of granite, by depriving moisture of a lodgment, vastly adds to the durability of the stone.

The Sandusky Portland Cement Co., of Sandusky, O., have supplied their waterproof compound for the following important work:

Reinforced Concrete Sewage Tank, Summit, N. J.
Concrete Powder Magazine, Pt. Bonito, Cal.
Agnes State Hospital, Agnes, Cal.
Clark Estates Hotel, Cooperstown, N .Y.
Sewage Purification Works, Lancaster, N. Y.
Commercial Bldg., Seattle, Wash.
Van Antwerp Bldg., Mobile, Ala.

Their Medusa White Portland Cement has also been used on the following work:

Merrill Residence, Seattle, Wash.
Normal School, Montclair, N. J.
Reinforced Concrete Bridges, Howard & Mission Sts., Spokane, Wash.
Library Bldg., Wellesley College, Wellesley, Mass.
Entrance, Kensington, Great Neck, Long Island.
Art Museum, Toledo, O.
Campbell Bldg., Oklahoma City, Okla.

An effort will be made to float bonds to the amount of $600,000 to build a 1,000-barrel cement plant on the property of the West Coast Portland Cement Company, on the Snake river in Idaho. J. M. Edwards, of Spokane, secretary of the company, has returned from Lime Point, where laboratory tests have been completed which are expected to satisfy eastern capitalists who have signified an intention of buying the bonds.

The Jamestown Portland Cement Corporation has recently been formed at Richmond, Va.; with a capitalization of $2,040,000. This company proposes to build a large plant on the James river, ten miles above Newport News. The factory will have a daily output of 4,000 barrels of Portland cement. A power plant of 4,000 horsepower capacity is to be installed, together with the electrical equipment, steam shovels, elevating and conveying equipment, kilns, driers, grinding machinery, etc. The engineers in charge are the American Cement Engineering Company, 315 Fifth avenue, New York City, and this company is to furnish the entire equipment. Ground for the foundation is now being removed, while the work on the building proper will begin on about June 15th.

ANOTHER NEW CEMENT MILL FOR MICHIGAN.

The Great Lakes Portland Cement Company is the name of a new organization at Milwaukee, Wis., with offices in the Chamber of Commerce building. They declare they have purchased property at St. Ignace, Mich., where they purpose to build an up-to-date cement mill. In a circular letter which they are sending out to cement dealers, they state.

"Our Company will enter into a contract with you, binding themselves to return to you the full amount in cement, of the stock of our Company which you purchase.

To a Cement dealer, we will sell fifty to one hundred shares of our stock at par, $10.00 per share; in all an investment of Five Hundred to One Thousand Dollars; which may be paid in cash, or one fourth down and the balance in three equal payments, at thirty, sixty and ninety days. By the terms of this contract, the purchaser acquires without cost to him, stock in this Company worth not less than $500 to $1,000 and the Company obtains an equally valuable asset, in an established market for its product, and in the strong co-operation of stockholders who come into direct contact with the consumer. In no case will we sell any one dealer more than One Thousand Dollars worth of our stock on these terms, unless he should be the owner and operator of more than one yard selling cement. In that case we will allow him to purchase, $500 to $1,000 worth of stock for each yard. Our stock is all common, fully paid and non-assessable, all stockholders share alike.

Our Company has set aside a small block, less than one-third of its capital stock, to be placed among the retail dealers in cement, for the purpose of establishing an assured market for the entire output of our plant and this reserve stock we wish to be so distributed, so that the entire output could be absorbed by those dealers owning its stock, thereby saving to our Company at least 10 per cent on value of its output for selling expenses. A large part of this stock has already been spoken for.

We do not mean to imply that any dealer purchasing our stock under these terms must obligate himself to handle our product exclusively. Our plant will be the most modern and our product in quality, second to none. We will be fully prepared for any competitive business and unless we equalize market conditions with others, we do not expect the trade.

In a proposition like this now offered you, there can be only two reasons for hesitation on the part of the dealer who sells cement. First: to be assured of the business standing, integrity and substantial dealing of those who invite your association and co-operation. We point with pride to the record of our officers. They are men of achievement, who do things. Their past successes in the financial and mercantile world should make for the unqualified success of this enterprise.

A second momentary hesitation may arise upon the question of possibility of evolving an operating profit on the plant and at the same time comply with the terms of this proposition. In response to the possibility of a doubt as to our being able to accomplish this, we call your attention to the following figures, based upon the most conservative estimates, practically amounting to certainties, which must convince the most skeptical that our policy is sound.

Annual Output of Plant	1,000,000 Bbls.
Returned annually to 600 retail dealer : Stockholders 125 Bbls., each being one-fourth value of their Five Hundred Dollar investment, figuring f. o. b. Mill price would be $1.00 per barrel	75,000 Bbls.
Net output	925,000 Bbls.
At estimated profit per barrel	40c
Annual gross profits	$370,000
Less cost of production 75,000 bbls. returned to Retail dealers at 60c per barrel	45,000
	$325,000
Annual net profits on capital stock issue equal to 21 per cent	$325,000

The officers of the company are J. L. Babler, president; J. P. Hinton, vice president; J. L. Schallaire, general manager; Harry M. Rubey, treasurer and A. H. Blatchley, secretary.

A REINFORCED CONCRETE HOTEL IN TEXAS.

The Plaza is the name of a new hotel and resort nearing completion at Port Arthur, Tex. This hostelry was promoted by John W. Gates, of New York, and is one of the finest hotels on the Gulf. It will cost complete $100,000. It is entirely of reinforced concrete, plain round bars used.

It is 190 feet wide and has a depth of 150 feet, consisting of three stories and basement. The foundation is 36 inches below grade and rests on a 12″x48″ concrete slab. The basement walls are 22″ trick. The walls of the first story are 18′ high and 17″ thick. The second floor walls are 12″ thick and the third floor walls are 8″ thick.

The floors are laid of concrete slabs 6″ thick.

In mixing the concrete a Cube mixer was used and the concrete was placed at the rate of forty to eighty yards per day. The concrete aggregate was composed of Kansas City Portland cement, a poor grade of beach sand, clean but very fine and smooth, and medium clam shells, which are rather soft. The aggregate for the floor slabs, walls, etc., were mixed in proportions of 1—3½—4. In the columns the aggregate used was 1½—2—4.

In pouring the concrete from four to twelve feet was dumped into the forms and well spaded. The forms were allowed to stand ten days and the centering was not removed for two or three weeks.

The results were very satisfactory, and the walls free from imperfections and faults.

The building contains eighty guest rooms. The lobby, dining room, kitchen and Dutch room are large in proportion for handling excursionists.

The architect who designed the building is C. A. Logan, of Port Arthur. H. D. Applegate & Son, of Beaumont, Tex., are the general contractors, and the materials were supplied by the W. E. Hall Lumber Company, of Port Arthur.

The building was started in October, 1908, and is now all enclosed and plastered. The owners expect to have it open for business in June.

CONCRETE FLOOR WITHOUT BEAMS.

A new system of reinforcing concrete floors and carrying their loads, by radiating rods, directly to structural steel columns, without the use of beams and girders, has been designed and patented by Mr. O. N. Mueller, of Indianapolis, Ind., and is being placed before engineers and architects by the Noelke-Richards Iron Works, of that city. The columns are of ordinary structural steel design, of latticed angles, and are tied to each other by light channels, which merely act as spacers and are therefore made only sufficiently heavy to serve as re-

inforcement for the sides of the floor panels. The loads are not carried by these channels, but are transferred directly to the columns by the radiating rods. The channels are of the same depths as the floor slab, and by placing the centering for the latter against the bottoms of the channels a flat ceiling is secured.

A test panel built according to the system was recently tested to destruction at Indianapolis. It was 16 feet square and was designed for a safe live load of 150 pounds per square foot. No deflection was noticed until the live load, due to piled up pig iron, had reached 200 pounds per square foot, when the deflection was ⅛ inch which seemed to be caused principally by the failure of the foundation under one of the columns. The loading was continued to destruction, which occurred under a load of 612 pounds per square foot, the failure being in the center and due to the crushing of the concrete.

A NEW CONCRETE TEST.

In a paper read recently before the Society of Engineers, Dr. J. S. Owens, A. M. Inst. C. E., described the origin and application of a new test for determining the end of the mixing process in preparing concrete. The methods which have been tried in the past to achieve this result were described, three such being referred to: (1) Inspection; (2) making briquets, breaking when set, and noting if of uniform strength; and (3) mixing pigment with the concrete, making briquets, breaking when set, and examining fracture for even distribution of pigment. The author criticized these methods, and showed their lack of value for the purpose. He stated that it had been ascertained experimentally that inspection alone could not detect the difference between concrete having one part of cement to two of ballast, and that having one to three. The following definition of properly mixed concrete was then given: "Concrete in which the various ingredients are as uniformly distributed as the size of the particles composing them will admit." He went on to say: "The question, therefore, is how to determine when this uniformity of distribution has been attained." The principle on which the author's test is based was thus described: "If we take a few small samples from different parts of the heap of concrete, and if we can tell in some simple way whether all the samples contain the same relative proportions of stone, sand and cement, we have a means of telling whether the concrete is properly mixed or not." The author's method of comparing the samples is simply to place each in a tall glass cylinder nearly filled with water, shake them up, and allow them to settle. The rate of settlement of the cement in water was shown to be about thirty times as slow as that of the sand, which, in turn, was slower than that of the larger particles of stone; this caused the stone, sand and cement to settle on the bottom in distinct layers. It was shown that the depth of these layers was proportional to the amount of the material present in the sample, and that in this way it was possible to tell whether each sample had the same amount of cement, sand and stone.

MARKET QUOTATIONS.

		Par	Capital	Rate	Daily Capc'ty Bbls.	Bid	Ask
Ash Grove Lime & Port. Cement Co., com.		$100	$2,000,000	—	2,500	$22	25
do	preferred	100	750,000	7		75	80
do	6 per cent bonds	500	750,000	6		80	85
Altoona Portland Cement Co., pref.		100	600,000	7	1,800	70	75
do	common	100	1,400,000	—		20	25
Bonner Portland Cement Co., pref.		100	1,000,000	7	1,000	—	45
do	common	100	1,000,000	—		—	5
Dewey Portland Cement Co., pref.		100	1,000,000	7	2,500	75	80
do	common	100	1,000,000	—		20	25
Dixie Portland Cement Co., pref.		100	1,100,000	7	3,000	73	80
do	common	100	1,600,000	—		20	25
Iola Portland Cement Co., pref.		25	1,500,000	7	6,000	22	23.25
do	common	25	3,000,000	4		23	25
*Iowa Portland Cement Co., pref.		100	1,200,000	7	3,500	—	80
do	common	100	1,700,000	—		—	25
*Monarch Portland Cement Co., pref.		100	2,000,000	—	1,000	—	70
do	common	100	2,000,000	—		—	20
Northwestern States P. C. Co., pref.		100	1,750,000	7	3,500	70	80
do	common	100	1,750,000	—		20	25
U. S. Portland Cement Co., pref.		10	400,000	7	1,000	—	7
do	common	10	500,000	—		1.50	3
do	bonds		200,000	6		—	100
United Ks. Port. Cement Co., pref.		100	4,250,000	7	8,000	51	55
do	common	100	8,500,000	—		6	8
Western States Portland Cement Co.		100	1,500,000	7	3,500	73	80
do	common	100	2,000,000	—		24	28

*Building. Will make cement in 60 days.

The Canadian Portland Cement Co.'s Works at Port Colburn and Marlbank, Ont., shipped 11,000 barrels of cement to Fort William, Lake Superior for distribution to Manitoba, Alberta and Saskatchewan.

INCORPORATED.

The Sterling Portland Cement Co. of Delaware, capital $1,800,000, works at Louisiana, Missouria, with a local Missouri capital of $50,000.

Chairman McNabb of the ordinance committee of the city of Grand Rapids Council, is preparing an ordinance regulating the manufacture of concrete building blocks, with the view of excluding improperly made blocks.

The Kosmos Portland Cement company are installing a Duehring continuous feed Automatic Scale supplied by F. H. Schule Company, 114 Liberty street, New York City, who are also furnishing the Southern California Portland cement company with similar scales.

The William Murdock Cement Block Co. of Milwaukee, is turning out 1,500 blocks per day, with an increasing demand as the season opens. A large number of houses are to be erected in West Allis this season of cement blocks.

An ancient concrete arch bridge in the South of France known as Pont du Gard built 56 B. C., therefore 1965 years old is still in a good state of preservation.

Several concrete lamp posts have been erected on Massachusetts ave., Washington, D. C., to determine their utility. These posts are brightly ornamented.

Oklahoma City, Oklahoma, has twenty-five cement block factories, all running on full time. Some have night shifts. One company claims to be turning out over 3,000 blocks every 24 hours by running all night.

CONCRETE FENCE POSTS.

From observation of concrete fence posts your committee considers that the concrete post will have very little or not all, as posts set from two to five years ago are at present in almost perfect alinement, and not a loose or broken post was found. They appear sufficiently strong for all practical purposes after being properly cured and set. The claim that concrete posts reinforced with steel form lightning protectors appears reasonable. They will, of course, resist the action of fire and decay. They will not float and cannot be displaced so easily as wood posts. On the other hand, concrete posts must be carefully handled in loading and unloading and well cured before using. Fence wire in contact with their surfaces should be well galvanized. The concrete post is much heavier than the wood post and the cost of distributing and setting is about 25 per cent greater.

It would seem that the concrete post is particularly adapted to railroad use. Most of the post machines are cheap and portable and the materials used are in daily use on all roads using concrete; the materials are cheap and easily obtained.

Your committee corresponded with over 20 manufacturers of posts and postmaking machinery in the United States and Canada. A majority of these firms use or advise the use of Portland cement and gravel varying from the size of sand to pebbles which will pass a wire screen having meshes of from ½ to 1 in. sq. The ratio of cement and gravel is as 1 to 4. The methods of reinforcing and tamping concrete posts vary almost as much as those of fastening the fence wire to the posts. The machines are of various capacities and design—from the one-post hand mold to the "post per minute" power machine with continuous mixer attachment. The average total cubic content of the 7-ft. post is 0.825 cu. ft.; of the 8-ft. post, 0.95 cu. ft. The weights vary from 65 lbs. to 95 lbs., according to methods of manufacture and reinforcement used. Concrete posts retail for from 25 to 35 cents per post. End and gate posts are of about three times the volume and cost of intermediate posts. In section, concrete posts vary from square or rectangular to triangular, half-round and circular. Reinforcements are of wire, wood, strap steel, steel and wire truss, wood and wire truss, chain scrap strips and expanded metal. Fence wire fastenings are also of various forms—from the wire loop around the post to the patent staple encasement. All the posts observed taper from a smaller top to a larger base. Some have very wide concrete block bases.

In response to invitations sent to all manufacturers four concrete post machine firms demonstrated their machines at Bay City, Mich., making 12 reinforced concrete posts each, which were tested at the Michigan Agricultural College.

These posts were tested for tensile strength; panels were erected to test the holding power of the fence in place as well as give the set posts impact tests and, if possible, to compare their strength of resistance to impact with wooden posts. They were tested in a machine of large capacity, 42-in. span, both ends supported, load applied in center. The following results were obtained at an average of 7 to 12 posts of each sort so tested:

Name of Mfr.	First crack	Maximum wt. post broken.	Deflection in inches.
D ..	458 lbs.	1,090 lbs.	0.65
B ...	648 lbs.	1,071 lbs.	0.70
A ...	564 lbs.	1,020 lbs.	0.53
C ...	927 lbs.	1,356 lbs.	0.66

The comparative results show the ipmortance of thorough tamping and stiff reinforcement near the surface of the post. A cedar post of dimensions identical with the average of these concrete posts would weigh about one-fourth as much and be four times as strong. The results in practice show that the wood posts used are much stronger than necessary rather than that concrete posts are not strong enough.

*Extract from report of Committee on Signs, Fences, Crossings and Cattle Guards to the American Railway Engineering and Maintenance of Way Association.

A cement shingle factory has been organized at Marysville, Ohio. The plant will be located on Milford ave. near the Big Four Ry. tracks. The new company is composed of H. T. Creviston and Milton Green, of East Liberty; Brough Dunham, George M. Wilber and Isaac McMonigal, of Marysville.

CONCRETE STEEL FLOOR CONSTRUCTION.

An interesting system of concrete-steel floor construction has been recently placed on the market. It is claimed to save from 4 to 12 cents per square foot of floor over any other system of floor construction now in use. The following is a general description:

It is a panel construction consisting of a flat slab of reinforced concrete supported by structural steel or reinforced concrete beams, which divide the ceiling into square or rectangular panels. The slab is reinforced by two independent layers of bars placed at the top and at the bottom thereof; the bars in the top layer are placed across the beams and over the columns, and the bars in the bottom layer run in two directions parallel to the beams of the panel. The bars in the top layer are preferably wired into units in advance and the units are dropped into place immediately after the concrete is cast.

The patentee of the system, Mr. Leibu Hermann, C. E., New York, N. Y., has just issued a descriptive pamphlet, which will be sent free to interested parties. He will submit estimates and give suggestions as to the general design of any contemplated construction.

The Belvidere Cement Products Co., Belvidere, Ill., has been incorporated with a capital stock of $15,000 by Chas. Frederickson, Sylvester E. Griffith, W. H. Mitchell, and a number of others for general manufacturing purposes.

NEW PLANT IN OKLAHOMA.

During the present month, or early in July, work will begin on the construction of a cement plant near Ardmore, Okla., to cost one million dollars. The plant will be situated at the foot of the Arbuckle Mountains, a few miles west, and will have a capacity of 5,000 barrels. Along with this plant a railroad is to be constructed extending from Ardmore probably to Chickasha and traversing the Arbuckle Mountains.

The company of promoters consists of E. S. Ayers of Edgerton, Kan.; W. W. Fry and Oscar Avers of Olathe, Kan.; L. J. Middleton and C. R. Goodale of Collinsville, Okla., and Philip Lawrence of Buton, S. D. They have floated bonds for carrying out their plans and their plant will be the largest of its kind in the southwest.

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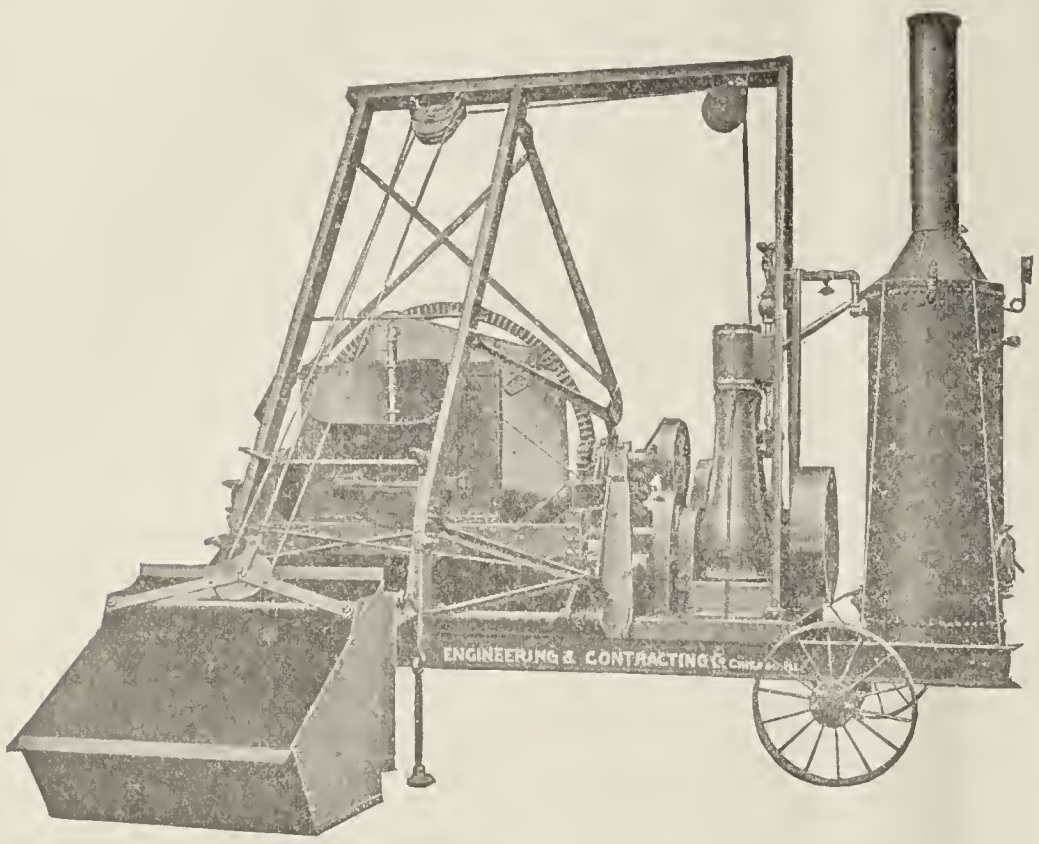
THESE MIXERS ARE CHICAGO IMPROVED CUBE MIXERS and they are to be USED ON THE PANAMA CANAL. Their normal capacity is 54 cubic feet per batch; we claim 64 cubic feet; the inspection tests showed 75 cubic feet. The actual capacity surpassed the claimed maximum capacity 18½ per cent. and it surpassed the nominal capacity by 39 per cent.



THESE WERE STANDARD MIXERS—not designed especially for this order. The actual results discounted all claims. They do it in every claim made for Chicago Improved Cube Mixers—in correctness of principle, quality of material, in character of workmanship, amount of output, rapidity and ease of operation, in durability, and in quality of concrete. Such overload capacity is a fund of strength and resource to a Chicago Improved Cube Mixer Owner.

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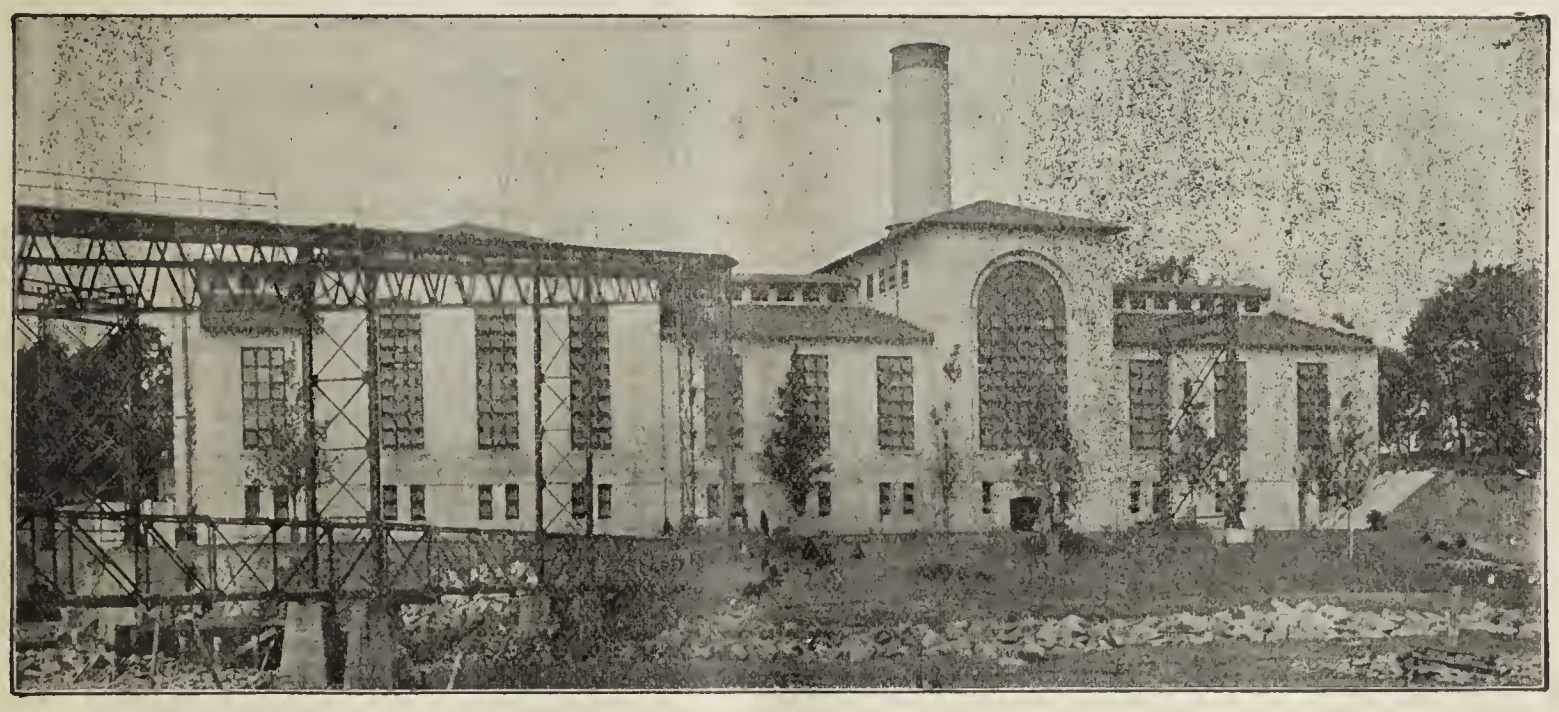

CEMENT BLOCK POWER HOUSE, N. Y. N. H., & H. R. R. Co., COSCOB, CONN.

Built of Hercules concrete stone by Westinghouse, Church, Kerr & Co., Engineers, New York City.

This building is over 250 feet wide and 50 feet high and required over 30,000 concrete blocks. An idea as to the size of this building can be realized from the fact that it contains 12 large Boilers and over 150 carloads of machinery. The machine for making the concrete blocks was manufactured in Rochester, N. Y., by the Century Cement Machine Company.

CEMENT AND ENGINEERING NEWS

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CHICAGO, JULY, 1909.

THIRD ANNUAL CEMENT SHOW.

The dates for the Third Annual Cement Show in the Coliseum, Chicago previously announced as February 17-23, 1910 have been changed to February 18-26, 1910. The show will open on the evening of February 18, and be open continuously until the evening of Saturday, February 26, being closed, however, on Sunday the 20th. Under the new dates the show will be open two days longer than the show held last February.

We announce with pleasure that the National Association of Cement Users have decided to hold their sixth annual convention in Chicago, on February 21-24, 1910, these dates being covered by the Third Annual Cement Show. The decision of the N. A. C. U. to hold their convention in Chicago during the Cement Show will mean that the gathering in Chicago February next will undoubtedly be the largest gathering of cement interests ever held in the world.

THE EVERLASTING CRY OF "POOR CEMENT."

When there is a failure in concrete construction work, the contractor usually charges the fault to poor cement, when in nine cases out of ten, the cause is far from such. It may be, the using of too small a proportion of cement, improper mixing or handling of incompetent supervision. The uniformly high grade Portland cement, now produced by our mills, leaves little to be desired in the way of quality. The best of Portland cements in the hands of inferior workman, can be made to produce bad work, simply by not pursuing proper methods. Experience is the best teacher. We note the case in which a concrete bridge had been constructed, and after being in use for some time, it was found that the concrete was full of pores in places; the town engineer claimed that this defect was due to bad cement made from inferior raw materials. This engineer claims too much in order to save his own reputation. He likewise stated that good Portland cement can only be made from limestone rock, and shale; which is untrue. It is well known that marl and chalk are equally as good as limestone rock, and that clay and carefully selected furnace slag, can be substituted for shale, in the manufacture of sound, first class cements. The trouble in located faults, is that no one is willing to assume the responsibility; therefore the cry of "bad cement' is pushed to the front as an excuse; cement always gets the black eye. Now and then we find a city official who trys to build up a reputation for doing concrete work economically by stinting on materials, especially cement, and when the work begins to show defects, it is charged to the cement being poor. There is a class of cheap cement contractors, who roam from place to place, taking jobs below the actual cost of materials and labor, for good work. They skimp their work, cheat their customers, and then fall back upon the cement dealer for damages, and ask for a large rebate on the price of the cement. They not only give the particular brand of cement a bad reputation, and thus injures the dealers future sales, but skip out without paying bills. It is a safe rule, to employ only reliable contractors where sound, durable work is desired. Dealers in building materials, often refuse to sell cement to men who have no financial standing, simply as a matter of self protection. This is a good rule, and should be more generally followed. A man must use brains, as well as good material in doing concrete work. The mills are furnishing good sound cement, but they cannot furnish the brains to work up the materials to produce the best results.

WROUGHT-IRON CEMENT-LINED WATER PIPE.

Experience in this country with wrought-iron cement-lined pipe systems for distribution purposes has in general been adverse and has led to its replacement with cast iron pipe, except, perhaps, under conditions where the pressure does not materially exceed 65 lbs. per sq. in. and where there has been but little disturbance of the ground adjacent to the pipe trench which might cause settlement or other injury to the pipe line.

Experience in this country with wrought-iron cement-lined pipe system for supply mains has been much more satisfactory than for pipe distribution systems, and many old wrought-iron cement-lined supply mains are still in active use and giving satisfactory and economical service, particularly under such conditions as are usual in the case of these supply mains—light pressure, secure foundation, and private rights of way within which the pipes are located, resulting in little danger of disturbance.

It is still possible that economical means will hereafter be developed for lining steel or even cast-iron pipe in a similar manner to that so successfully now employed in lining service pipes with cement, which will result in a better pipe than any yet used. But such use of cement is likely to be limited to furnishing a durable coating rather than water tightness and added strength to the pipe.

THE HARDENING PROCESS OF CEMENT.

In one of our next issues we shall publish a translation of the latest paper by Dr. W. Michaelis, Sr., of Berlin on the "Hardening of Hydraulic Cement." This paper, which was read in March of this year and which is appearing in German and French magazines at this time, is a continuation of Dr. W. Michaelis' paper on the "Hardening Process of Hydraulic Cements," which appeared in our columns in August, 1907, and which we published also in book form.

The former paper emphasized that the hydraulic hardening process was mainly due to the formation of colloids. It described the physical properties of these colloidal substances, but left unexplained how the hardening of these gelatinous or glue-like bodies was brought on under water. This latter point is described in the present paper to the entire satisfaction of the most eminent experts in colloidal chemistry and cement chemistry who regard this paper as an exhaustive and definite explanation of the hardening process of cements.

The physical properties of the colloidal substances taking a part in the hardening of the calcareous hydraulic cements have been the subject of a careful study during

the last ten years by Dr. W. Michaelis, Sr., of Berlin, and by Dr. W. Michaelis, Jr., of Chicago. Through their work has been determined to what degree each of the colloids present in cements is able to contribute to the hardening. Furthermore, the various ways have been described by them in which colloidal bodies harden, namely by pressing out of the water which they contain or by evaporation of the water into the atmosphere or by absorption of the water from within, that is to say by bodies imbedded in their interior, which extract the water and use it for hydration.

Before these various methods of hardening of colloids had been described and illustrated, the colloid theory was not universally accepted, as it did not satisfactorily explain the hardening of cements under water, which was ascribed to the solidification of the colloids. As colloids were known to harden only by loss of water, hardening of colloids kept under water was out of the question in the opinion of the layman. Thus as long as anything in the hardening process remained obscure, the explanations of the author of the colloid theory were opposed.

However, the results attained during the last years by the study of the physical properties of colloids and of the behavior of cements under varying conditions conclusively prove that colloids are formed immediately upon addition of water to hydraulic cements and that these colloids can harden only if the cement contains a sufficient amount of coarse grains to extract the water from the colloids, whereas a cement ground to extreme fineness is unable to harden, as the entire cement powder is immediately converted into a plastic dough and no coarse particles are left imbedded in it which may decompose in time and gradually extract the water from the gelatinous mass.

The present paper is accompanied by cuts illustrating the progress of the hardening. The process of crystallisation taking place during the hardening of cements is duly described and full credit is given to the formation of crystals in as much as it frequently contributes to increase the strength. However, the paper points out that crystallisation alone can never lead to the formation of a water-mortar and mentions as an illustration of this the hardening of gypsum, which is solely a process of crystallisation. For this reason hardened gypsum is not impervious to water and is softened by water. Alone the gradual drying out of the colloids formed on the surface of the cement grains is able to render the mortar impervious and to transform it into a "hydraulic" mortar, that is to say a water-resisting cement.

As the paper on the "Hardening Process of Hydraulic Cements" of two years ago aroused a general enthusiasm among our readers, we feel confident that the continuation of this paper, which we are about to publish, will be welcomed in a like manner by our subscribers, so much the more as this publication comprises the final result obtained from a 45 years' study by the foremost living cement expert whose theories and explanations were invariably attacked at the time, when they were first published, but which ultimately had to be acknowledged to be true in every instance and were found to be of the greatest importance to the practical cement user.

An English company capitalized at $5,000,000, has been formed to purchase the British patent rights of Dr. Heinrich Colleseus, of Berlin, covering a method of manufacturing Portland cement from the waste product of iron blast furnaces. The company expects to erect cement plants at different points, and to make a bid for export trade.

SOME PROBLEMS OF A CEMENT INSPECTING LABORATORY.

In considering this topic, this paper will discuss the problems of the laboratory which inspects cement proposed for use on work, rather than those of the laboratories of the cement mills or of those laboratories where cement is tested theoretically or experimentally. Of course, there are kindred ties between these laboratories, and all may be working under the same general methods, and yet between them there may be a considerable difference. These problems are not extraordinary ones, but are such as one in charge of an inspecting laboratory often has to meet and which is necessary for him to use time, experience and tact in trying to solve.

The work of most mill laboratories is usually that of testing only the product of the mill, and, in a certain sense, it becomes strictly routine, with only occasionally a problem for consideration; the problems of theories and of experiments interest other laboratory workers; but a laboratory which inspects and tests a great number of samples representing large quantities of cement of many different brands meets conditions which are perplexing and ofttimes are far from easy solution. Possibly some of these can not be called problems, and yet they are so out of routine work that they have to have special attention.

Theoretically, it would seem that there should be no need for inspecting laboratories, for do not the cement mills test and examine all cement made and shipped! And yet, what inspecting laboratory does not find that large numbers of samples of poor cement are submitted for tests? Just why it is so is not really explained. It must be that sometimes, the mill laboratory must make a mistake, for it would be uncharitable to call the presence of poor cement on the market the result of deliberate intention. So, in considering this subject, we will have to consider the inspecting laboratory as being a check on the mill laboratory; and although both may be working under similar methods, it is possible to find many differences in their results.

The very fact that such differences do occur is the cause of the greatest annoyance to the inspecting laboratory. There seems to be too general suspicion among representatives of the cement companies that a rejection of a lot of cement by an inspecting laboratory means one of two things:— either that the tests are crude and made by ignorant persons, who do not understand the first principles of cement testing, or that there is some hidden reason for making trouble for the company manufacturing the cement.

It is perfectly natural for the cement company, when their tests show the cement to be all right, to feel some resentment at a rejection of their product, but as long as a human being is liable to err, as long as there are no methods of testing that have absolutely no faults or weak spots, and just as long as inspecting laboratories find poor cement, just so long should the question first be raised, "Where is the mistake, in our laboratory or in the inspecting laboratory?" Both laboratories have a chance of making the error. The inspecting laboratory, before rejecting, should make check tests; the cement's representatives, before criticising, should learn the real conditions of the case, and after obtaining such knowledge, should then be fair in their judgment. An illustration would perhaps help bring out the thought. All cement to be used on state work of any nature in the State of New York has to be tested in the laboratory of the State Engineer and Surveyor. A shipment of cement for use on some State buildings was rejected. The representatives of the cement insisted that the cement was good and had been unfairly tested by the

State's testers; they threatened to compel, by means of the courts, the use of the cement. The whole case was the cause of a considerable controversy, and finally check tests were made by the president of the cement company on one hand and by the writer on the other. The writer's tests were found to give true results. The outcome of the whole case was that the cement company found a deliberate error in their own laboratory, apologies were made and the cement removed from the work.

It should be stated that this feeling of suspicion, or opposition, is generally between those laboratories of both classes, which have never had occasion to come into a position of mutual understanding; and the tendency seems to be toward recognizing the inspecting laboratory as having the best of motives, methods, and men.

Some of the differences between these laboratories are already receiving due consideration from the best sources. Take, for example, the matter of making tests for fineness. Uniform methods and uniform requirements have amounted to nothing when it was impossible to get uniform sieves. One of the hardest problems has been to secure a sieve of standard mesh and wire. As an example to illustrate this point:—Some time ago, some cement on a large piece of work was running very coarse. The first time this occurred the cement was accepted with a protest to the manufacturers that the cement would be rejected if it continued coarse. Well, it did, and a car-lot was rejected and the result was that a representative of the company visited the inspecting laboratory and protested against their sieves; he also brought his own standard sieve. Tests showed a difference in amount, passing the No. 100 sieves of over five per cent. Sieves of both parties had been bought as being standard. The manufacturer of the cement had a sieve which upon examination showed 92 meshes per linear inch, while the inspecting laboratory sieve was 102 meshes per linear inch.

This experience is not different from that many have had, but it emphasizes the need of getting together. This problem of sieves, however, is being solved, since it has become possible through the Committee on Technical Research of the Association of American Portland Cement Manufacturers to secure sieves that are truly standard.

Another problem of the inspecting laboratory is in regard to tests for sets. It seems that quite frequently a cement, that in tests made at the mill will show it to be a normal setting cement, will when sampled upon the work and tested in the laboratory show it to be a quick-setting cement. While it is known that temperature affects the setting of cement, still tests made at different temperatures with cement, air and water all at the same temperature will frequently show the flash set. A cement that will take an initial set in three minutes and a hard set in five minutes has something radically wrong; it is not a matter of temperature, or of consistency, as is usually claimed; but rather, we usually find it to lack a proper amount of added gypsum. The cement has, however, passed the mill laboratory tests and there is, therefore, a resulting controversy between the two parties.

Tests for tensile strength, we all know, will vary in the same and in different laboratories, so differences of opinion as to strength should be dealt with by having a re-test made in the inspecting laboratory with representatives of the manufacturers of the cement to watch and inspect the making of tests. It becomes one of the problems, however, of the inspecting laboratory how to treat cement fairly from the point of view of both user and manufacturer, and yet not use too great force in moulding the briquette. A good square test for strength without aiming to obtain abnormal results should be the intent of the inspecting laboratory. How to do this is the problem. We have prescribed a standard method of mixing the mortar and of moulding the briquette; and although the intent may be there to follow minutely the standard method, it often happens that a cement which is just near the required strength can be made to pass or fail because of the personal equation in the work of the operator. It is this condition which causes trouble; and, as has been suggested, here is the opportunity for a mutual test and no misunderstanding.

It is also a live question as to what an inspecting laboratory should do in regard to the kind of sand to use in making standard tests. Of course, we know that the "Ottawa" sand makes a denser and stronger briquette; and that because it does do so, it is necessary, before its use can be adopted, to have a large series of tests with all brands of cements in order that the inspecting laboratory may obtain the relative value of the sands under its own tests. By using the same requirements with the new sand as with the old, there would frequently pass a cement that would have failed with the quartz sand. So, in other words, it is necessary to raise the requirements, but just how much is fair is the question.

"Green," or "uncured," cement is also a condition that causes difference of opinion; but while the difference is being discussed, the cement may have improved, so this is not a very serious problem, although it often produces much annoyance to the contractor because of the delay.

The inspecting laboratory, too, has the same problem to deal with that mill representatives do in regard to the ignorance of users of cement who often have crude ideas of cement testing and who make crude or field tests of cement. These persons, sometimes they may be engineers, will not know the characteristics of the cement they are using and will imagine something wrong with good cement. Their crude tests will perhaps confirm their ideas.

Proper sampling of cement is also hard to obtain. Recently we received a lot of 12 barrels, supposedly taken from every tenth barrel of a lot of 120 barrels. The cement had a "flash" set, and was rejected. A duplicate lot of 12 samples, taken from the same lot of cement, were slow setting and considerably darker in color than the first samples. Upon inquiry as to what this difference in color might indicate as to the sampling, the reply contained the suggestion: "The cement left over in the laboratory from the testing of the original samples had, through exposure to the atmosphere, undoubtedly 'bleached out.'"

It might be said that a proper interpretation of specifications for cement is a serious problem. Shall the interpretation be literal or liberal? It stands to reason that, if, for example, tests of cement show the cement to be good in all the requirements except fineness, the cement could be used without harm to the work. On the other hand, if the use of this cement is permitted, how is it going to be possible to strictly draw a line in other particulars?

The inspecting laboratory is in existence to protect the interests of the user of cement, and all the questions before it have to be considered from the point of view of such user, and all other views must be secondary, but should be treated with the idea of having a "square deal" for all.

A CONCRETE CONDUIT.

The city of St. Louis has, during the past two or three years, witnessed some radical departures from accepted methods of conduit construction. During the year 1906 the electric light and power interests of that city found it desirable to install considerable conduit incidental to an extension of the system of distributing

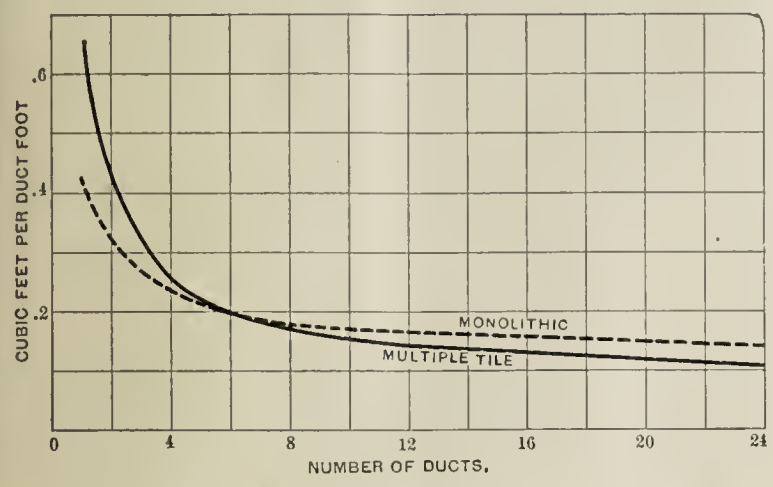


Fig. 1.—Curve of Concrete Per Duct-Foot.

electricity for general use and for extending high-tension feeders to reach distant street-railway substations. A fairly large stock of multiple-duct tile conduit was on hand, but not in sufficient quantity for the requirements of the work contemplated. An investigation of the conduit market developed a condition not at all encouraging to those responsible for the completion of the work in hand within the required time, in that all of the conduit manufacturers were then already sold out of the kind of duct desired. This state of affairs made it nec-

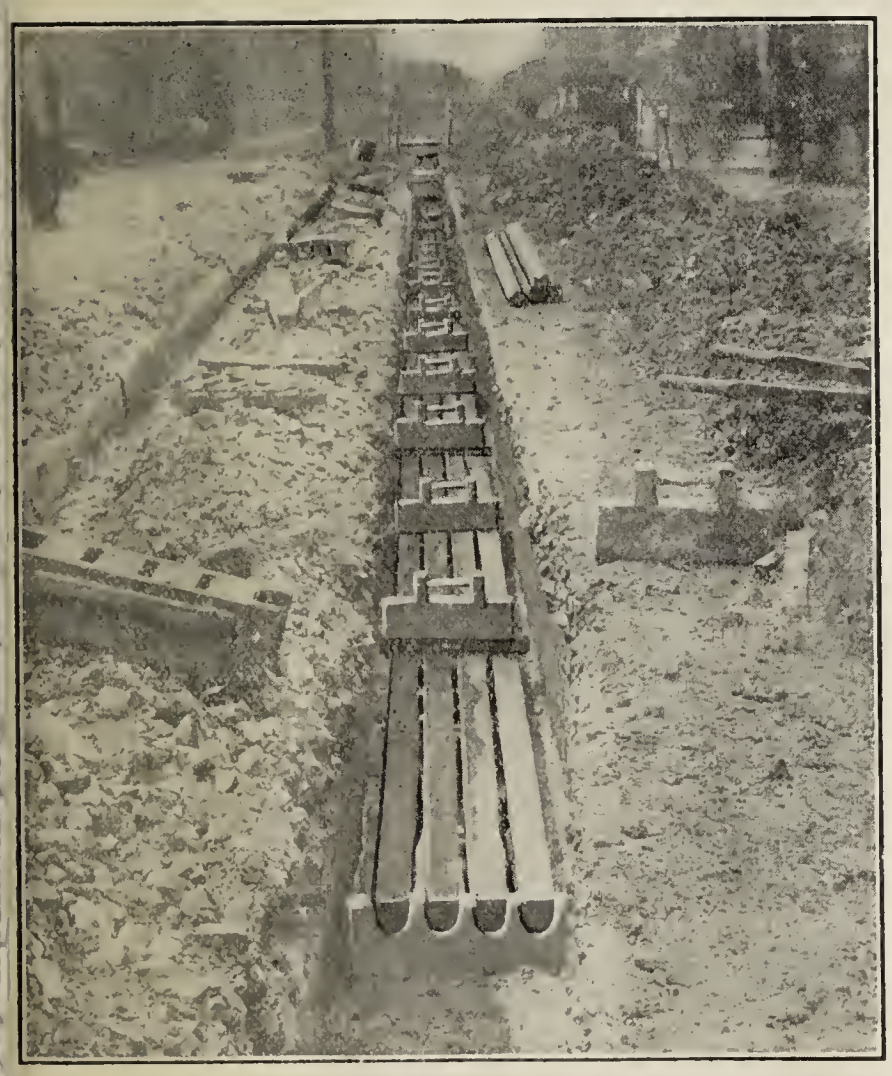


Fig. 2.—Trenches with Forms Ready for Concrete.

essary for the engineers in charge of the work to choose between completing the work with such conduit as could be purchased and delivered within the time limit or to devise some means of building a conduit without the usual tile or other pipe. The engineers chose to make an attempt to get along without the pipe, and incidentally save money in the cost of construction. This resulted in building a conduit entirely of concrete.

Upward of 170,000 duct-ft. of all-concrete or monolithic conduit has been laid in St. Louis within the last three years; fulfilling every requirement for all uses, from single duct runs with frequent junction or service boxes, to replace Edison tube, to heavy isolated runs for high-tension cable.

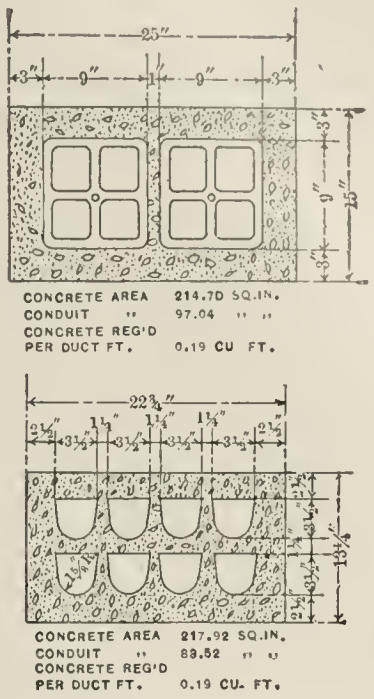


Fig. 3.—Comparative Dimensions of Standard Tile and Monolithic Conduit.

The ideal conduit, or housing, for underground conductors must have smooth, clear, jointless, fireproof duct openings, free from pockets or depressions in which

Fig. 4.—Open-Top Ducts with Concrete Covers.

water may lodge; should be laid to true grade to drain to manholes; must be constructed of a material of high electrical resistance, and which will be homogeneous and not deteriorate with age; must be strong and able to sustain itself and a considerable load over fairly long spans, and it must be cheap.

The almost universally accepted practice in this country of constructing conduits of single or multiple clay

tile, fiber wood, cement or iron pipe, with a jacket or supporting armor of concrete, obviously falls far short of the ideal construction. Any of these methods of constructing ducts depend on the concrete armor for strength and ability to withstand the usual cuts, excavation and city improvements continually met with in the streets of large cities; and if the concrete armor is weakened or carelessly applied, the pipes of various kinds resemble beads strung upon a wire and serve no useful purpose except to provide a hole or duct of uncertain size, smoothness and continuity between manholes.

In constructing a conduit with clay or other pipe as a means of obtaining the duct openings, a bottom layer of concrete is thrown into the trench and leveled off, after which the pipe structure is built up on the concrete, necessitating the presence of workmen in the trench and the handling of a large amouut of heavy material, which, even with the most careful methods, causes quantities of earth to be carried into the trench and deposited onto the concrete, seriously interfering with the bond between the bottom layer of concrete and the sides and top of the concrete armor or envelope, materially weakening the structure. In laying the pipes it is difficult to obtain perfect alignment and sealing. Each new section of pipe must be fitted to the preceding one, which jars or moves the pipe already laid to a greater or less extent, depending upon the skill of the workman and the quantity of the material he is using. After the pipes are laid there is no absolute inspection of the ducts possible, and the only information the owner can obtain relating to the presence of foreign matter, alignment and sealing is derived from the passage of a short mandrel through the various ducts. Drawing a mandrel through a duct can do no more than demonstrate that there exists a hole sufficiently large and straight to permit the mandrel to pass through it. It is desirable in any conduit that the ducts be completely isolated from each other and that the ducts be free from water-pockets or depressions and present a large and smooth surface as a bed for the cable, in order that ground currents may be equally distributed over the greatest possible area of the cable sheath, so that local electrolytic action may be minimized. Conduits built up of single-duct tile or pipe offer greater isolation of individual ducts, but are more expensive to construct than conduits built up of multiple-duct tile. Multiple-duct tiles afford communication between all of the ducts in the tile at every joint, or at points 3 ft. apart, and such construction permits a burning cable to throw fire and hot metal through the joints to the other ducts in the tile, even though the tile partitons between the ducts are not melted or evaporated by the arc, which is the usual result following a cable burn-out in tile construction.

It has been found that all-concrete or monolithic conduit possesses many advantages over a conduit built up of pipes of whatever nature, in that with such construction the structure become homogenous; occupies less space for a given number of ducts of equal size; permits perfect inspection of each duct from end to end **incidental** to the laying of each tier; provides smooth, straight, clear, jointless and fireproof duct openings from manhole to manhole; eliminates handling, fitting, breakage and cost of pipe; requires no factory, and but few and simple special tools; and for average duct sections uses no more material (concrete) than is required for the armor or envelope of pipe construction. The amount of concrete per duct-foot required for various duct sections for multiple-duct tile and for monolithic conduit and the cost per duct-foot of completed work, exclusive of trenching, refilling and repaving, are shown by curves in Fig. 1. These curves were plotted from results obtained in actually laying a considerable quantity of each type of conduit under the same supervision and by the same men. The multiple-duct tile was laid with a 3-in. armor of concrete and with the interstices between the tiles filled with fine concrete, while the monolithic conduit was provided with 2½ in. of concrete between the ducts and the bottom and sides of the trench, with a cover or top 3 in. thick. The items of trenching, refilling and repaving are nearly constant for each type of conduit, except a small differential of about ½ cent per duct-foot in favor of monolithic conduit due to the smaller trench and consequent reduced excavation and hauling of displaced earth required by the monolithic construction. Typical cross-sections of multiple-duct tile monolithic conduit are shown in Fig. 3.

The construction of monolithic conduit involves only the comparatively simple methods of good concrete work. After a trench of suitable width and depth has been excavated, duct-form support are set to grade and perfect alignment on 16-ft. centers in the bottom of the trench. These duct-form supports serve to hold the forms or molds for producing the duct openings rapidly in place and in true alignment while the concrete is worked in place in the bottom of the trench. The duct forms or molds consist of 16-ft. sections of clear, straight-grained lumber previously dressed to the shape of a "U," and are held down in the duct-form supports against the buoyancy of the plastic concrete by suitable cast-iron, or other weights. When the duct forms are set, concrete of the proper mixture for good concrete work is dumped into the trench and suitably rammed and puddled around the forms and finally struck off level with the tops of the molds. The concrete is then allowed to take its initial set, which in favorable weather requires about three hours, when the duct forms may be removed by simply lifting them upward and out of the concrete, leaving smooth, straight, continuous U-shaped grooves in the bed of concrete just laid, which, when covered, constitute the duct openings. Fig. 2 shows the trench with forms set ready for the concrete to be dumped in.

After the duct forms are removed from the concrete, the smooth, continuous grooves molded in the concrete by the forms are open to the daylight for the full length of the construction and every possible facility is afforded for perfect and rapid inspection. Any faults in the work may be instantly detected, and this in itself is a potent factor in securing first-class work.

The open top ducts are closed in by laying across the top of the structure thin, smooth plates, or slabs, of concrete molded on the site of the work. These slabs, or plates, of concrete are made of just sufficient width to lap over each outside duct a short distance, and are laid as illustrated in Fig. 4, with a small quantity of mortar to seal the joints. The thin concrete slabs, or plates, serve the double purpose of closing in the top of the newly formed ducts and as a foundation or support for the next layer of concrete in which an additional tier of ducts may be formed in the same manner as the preceding tier, this operation being repeated as often as necessary to produce the required number of duct openings. The top of the conduit is closed in in the same manner, with the exception that the top layer of concrete contains no duct forms and acts simply as an armor or envelope to protect the conduit construction from future excavators.

In addition to its lower first cost and other important advantages, monolithic conduit is especially well adapted to be used as a conduit for local distribution. "Blind-handholes, or service boxes, are readily molded in the concrete structure intercepting any desired number of ducts. In molding these handholes or service boxes, the

duct forms are allowed to pass through and the concrete flowing around the duct forms is stopped off by suitable forms arranged to fit closely around the duct molds. Such handholes or service boxes can be installed at as frequent intervals as desired without increasing the cost of the construction, inasmuch as no additional material is required. The top of the handhole or service box is closed in after the conduit is finished by a suitable cast iron or concrete cover, made loose so as to be removed readily in case it is desired to open the box for taking off services. Monolithic conduit has been laid under a great variety of street conditions and during all seasons of the year with perfect success and with a material saving in cost over the various pipe methods of duct construction.

CONCRETE IN MINE SUPPORT.

A Summary of the Situations in Which Concrete May Replace Timber.

The growing scarcity of suitable timber for mine support in many parts of the United States has made the substitution of some other material an imperative necessity. Abroad, stone and brick have been used to some extent, but they have not found favor in American practice, primarily because of the high cost of transportation but also because neither material is impervious to water. Of all possible materials, concrete seems to be best adapted as a substitute for timber. It can be placed more readily, and with less skilled labor, than either brick or stone; hence its first cost is likely to be considerably less. It takes several times as long to set concrete as to place timbers, and the first cost is from 25 to 45 per cent higher, depending largely on the shape of the construction; but compared with timber concrete has great strength and when once constructed is practically indestructible. It is rapidly growing in favor for a large number of purposes in mining work, of which the following abstract of an article by Mr. W. R. Crane in the Mining and Scientific Press for February 27 gives a brief summary.

One of the principal uses of concrete so far has been for lining shafts. When brick or stone is used for this purpose a circular or elliptical form has to be adopted for the shaft. Though several rectangular shaft linings have been constructed of concrete the elliptical or circular shape is to be preferred, especially when the concrete is placed in the form of blocks. The curved form is not economical of space but, on account of its superior strength, only about half the thickness of lining required in rectangular shafts is necessary, and the excavation is actually reduced, while the cost of the concrete lining is practically halved.

Numerous striking examples of concrete linings for steeply inclined shafts are to be found in the Lake Superior copper region. The shafts are inclined from 35 to 80 degrees from the horizontal, and, in the larger mines, have two hoisting compartments and a manway. Usually the upper part passes through 40 to 80 feet of water-bearing glacial drift. Arched linings are built through this stratum, which are carefully connected with bed rock, drainage holes being provided through which the excess of water can escape. Rectangular linings have been placed in four vertical shafts recently sunk at Lackawanna collieries in the vicinity of Scranton, Pa., passing through 60 to 75 feet of soft material before encountering bed rock. An interesting elliptical shaft, 23 feet by 15 feet inside measurement, at Bridgeport, Pa., has 81 feet of concrete lining. This was put down as a sinking lining or drop shaft. Concrete was placed in about 30 feet of forms built on a heavy timber shoe with an angle-iron cutting edge, after the latter had been levelled in the initial excavation. After ten days the outside members of the forms were removed and the lining was lowered to bed rock in the usual manner in sinking with a drop shaft. This method has been employed in sinking through quick-sand at Biwabik, on the Mesabi range, the reinforced-concrete lining being built up in 8-foot sections as the excavation proceeded. Concrete has also been employed for relining timbered workings, notably in the Manville shaft, near Scranton.

In tunnel work, two or more lines of track necessitate an arched roof; the lining of single-track tunnels may be rectangular or oval. In double track tunnels the compartments are usually separated by longitudinal partitions of concrete, plain or reinforced. A very successful application of concrete arches and columns for tunnel supports has been made in the mines of the Philadelphia and Reading Coal and Iron Co. Concrete arches, 18 inches square, replace 14 to 16 inch posts and caps, lagged with 4 to 6 inch round timber, and spaced 5 feet center to center. . Old rails and old wire rope are used for reinforcement. The cost approximates $22 per arch.

Large concrete columns are successfully used for supporting the roof at points where it is important that no settlement should take place, such as the intersection or roadways, where wooden rock-filled cribs or timber supports would be unsatisfactory. Concrete is being widely employed in both coal and metal mines for supporting and lining shaft and pump stations, and special rooms, such as underground offices, hospitals, lamp rooms and stables, are now being built of this material.

In the Pennsylvania coal fields the preservative treatment of mine timber has been undertaken on a large scale by a number of the leading companies. It is interesting to note, however, that the company which has experimented most extensively with concrete props, the Reading, proposes to build a plant at the North Franklin colliery, where such props will be manufactured for distribution to neighboring properties.

The possible applications of concrete peculiar to coal mining are very numerous. In Europe it is widely employed for the support of weak roofs where thick coal seams are worked in benches. Each bench, when the one above is excavated, is covered with a bed of concrete 8 to 10 inches thick, placed in sections transversely to the working face. Upon this bed of concrete is placed the filling with which the excavation is stowed on the removal of the coal, and by it the filling is supported while the next bench is being excavated. The concrete also serves as a support for the tracks. Concrete is being used in the construction of the overcasts of air-ways; in some places it is replacing wood and stone. The problem of ensuring brattices and air stoppings against danger from explosions has been solved by the employment of concrete; its use for this purpose is now common practice.

Reinforced concrete has been used in the construction of very heavy bulkheads in the Ontario adit of the Daly-West mine. One of the first uses to which it was put was that of building foundations for heavy machinery, both on the surface and underground. Intercepting ditch construction of concrete is now quite commonly used. An important application is in the support of mine tracks. Large longitudinal stringers are built, upon which the rails are mounted and to which they are securely bolted, a type of construction used in a number of the Lake Superior copper mines.

A further extension in the use of concrete in and about mines is its employment in the construction of powder magazines.

Mr. Crane illustrates a number of the structures referred to in his paper and concludes with a short bibliography of the subject of concrete in mines.

CONCRETE POLES.

At the recent meeting of the Oklahoma Electric Light, Railway & Gas Association, a paper on the construction of concrete poles was presented by Mr. J. M. Brown, superintendent of the Oklahoma Gas & Electric Company. An abstract of this paper appears below:

The poles are made hexagonal in shape and hollow in the center. A 35-pole is 7 in. across the corners at the top and 16 in. across at the butt. The forms are arranged so that by adding sections 5 ft. long to either end, poles of any length can be molded. The forms are made of heavy timber to avoid warping and are built in two halves which are clamped together and accurately lined up to insure the pole being straight. High-carbon-

Placing a Concrete Pole in Position.

steel, 12¼-in. deformed-section reinforcing rods are then put in place symmetrically about the central axis. At the top of the pole the rods are secured by passing them about 2 in. through holes in a steel plate, bending over the ends and then bolting down a second plate on the bent-over ends with four small bolts. The rods are then stretched and anchored in the butt as follows: The ends of the rods project about 6 in. through holes in a steel plate fastened in the form. Pieces of ½-in. steel rod 10 in. long with an eye formed in one end and threads on the other end are used for stretching. The ends of the reinforcing rods are bent over and hooked into the eyes of the stretchers and short pieces of pipe are passed over the stretchers butting against the steel plate. A nut and washer bearing on the outer end of the piece of pipe is screwed down on the threaded end of the stretcher, giving any desired tension to the rods. The form is then ready for placing the core, which is made in two sections, telescoping with each other. The core is wrapped with one thickness of building paper and is hung in the center of the mold by suspension wires placed at intervals along the length of the form.

The concrete used consists of a mixture of one part cement, two parts sand and three parts chats or zinc tailings which can be obtained in large quantities from the zinc mines of southwestern Missouri. With cement costing $1.50 per barrel, sand at $2 per cubic yard, chats at $2 per cubic yard and labor at $2 per day of eight hours, the cost of manufacturing a 35-ft. pole 7 in. across at the top averages $10. Three men can make three poles per day. Poles have been molded, hauled 3½ miles and set in five days' time, but this requires very careful handling and a longer time should be allowed for the concrete to set thoroughly. A 35-ft. pole molded, hauled to place and set, with steel cross-arms and pins mounted ready for stringing wires, costs $18.

The advantages for concrete poles are numerous. They are more rigid than wooden poles and wires do not swing as much as when mounted on wooden poles. The maintenance cost and depreciation are practically negligible. They resist lightning discharges and accidental grounds, can be erected with no more trouble than wooden or steel poles and can be climbed for inspection or repairs as easily as a steel pole. Being hollow, wires can be run down inside, where they are protected from the weather and mechanical injury. The accompanying illustration shows a pole on a track and another in process of erection.

TWELVE THOUSAND BRICK PER DAY.

The manufacture of cement brick is steadily growing into a business almost as important as the concrete block business and many plants that have heretofore operated block machines only, are having calls for cement brick and are installing machines for turning out this product also.

The Peerless cement brick machine has been on the market for some time and is familiar to most of the readers. The company making this machine has just perfected a tamping attachment that more than doubles the capacity of the machine, at no great additional cost. The Peerless brick machine, 1909 model, shows the new tamping arrangement by means of which the ten brick are tamped at one operation. The manufacturers claim that one man can make 12,000 perfect cement brick on this machine in a day of ten hours. That is going some for a machine without power, and the 1909 model is sure to become popular with concrete men who are looking for cement brick making equipment. The new Peerless catalog, just issued, contains many valuable hints for people who contemplate entering this line of business, and may be had by addressing the Peerless Brick Machine Co., 69 N. 6th St., Minneapolis, Minn.

A NEW CEMENT PLANT FOR COSTA RICA.

The Moin Development Co., according to reports, is going to build a Portland cement mill at Moin, Costa Rica, near Port Limon, and would like to hear from designers of cement plants, manufacturers of cement machinery and machinery for concrete building material. O. C. Kilgour, Cristobal, C. Z., Panama, is secretary of the company.

CONCRETE STANDS FIRE TEST WELL.

A bulletin describing the fire-resistive qualities of building materials will be issued within a short time by the United States Geological Survey, through its Technological Branch. Various materials used in building were subjected to the direct application of heat for two hours in the laboratories of the National Board of Fire Underwriters, in Chicago, the temperature reaching that of a conflagration. After being exposed to the fire the materials were withdrawn from the furnace and quenched with water, in order to get the conditions that would obtain after the firemen had begun their work on a burning building.

The investigations, which were conducted under the direction of Richard L. Humphrey, engineer in charge of the structural materials laboratory of the Survey, are the first of a comprehensive series undertaken with the object of determining the fire-resistive properties and rates of heat conductivity of various building materials and the comparative efficiency of the various methods of fire-proofing. The investigations have the further object of greatly lessening the liability of loss by fire in government buildings which are not insured and greatly reducing their cost through more efficient methods of construction. While the tests are conducted primarily for the purpose of obtaining information of essential value to the government, it is believed that the results will prove of much importance to the public.

Mr. Humphrey in his bulletin gives the following caution: "Inasmuch as the tests herein recorded present many features of considerable importance, it has been deemed highly desirable to publish a detailed account of them, although the results are preliminary and inconclusive, and are presented solely for the purpose of making public the information required. They should not, therefore, be used as a basis for making conclusions, but merely as preliminary data regarding the relative fire-resistive qualities of the building materials tested."

Regarding the tests themselves, Mr. Humphrey says: "The conditions under which these tests were made were unusually severe, and none of the materials passed perfectly. The temperatures used would hardly be reached in an ordinary fire.

"Much of the damage done to the building materials in this series of tests was occasioned by internal stresses, the gas flame of the furnace heating one face of the test pieces much more rapidly than the other. All the materials tested, including the hydraulic pressed brick, cracked more or less. The concrete cracked least, but the tests indicate the necessity for using metal reinforcement in concrete walls to distribute the effect of the expansion.

"The fact brought out most clearly by these tests is the low rate of heat transmission of Portland cement concretes and mortars. This is one of the desirable qualities in buildings intended for fire-proofing purposes. For marking the cement blocks, linen tags were fastened by wire nails to the interior walls at the time of molding. Most of these tags remained in place during the test, and when the walls were demolished the tags in every case were found entirely undamaged.

"An average of all the tests shows that about 90 per cent of the maximum temperatures attained by the faces of the panels were reached in one hour, while in the case of the mortar blocks the increase in temperature of the backs of the panels in one hour was only about 20 per cent of the total increase in the two hours. Of the solid concrete panels, the cinder concrete showed the smallest increase in the temperatures of the backs of the walls, and the granite concrete the largest. The total increase in the temperatures of the mortar panels was about the same as the total increase in the temperatures of the backs of the concrete, but the increase in one hour was somewhat greater in the care of concrete.

"The damage done to the faces of the mortar and concrete panels would probably be caused at a temperature about half that of the maximum temperatures reached, owing to the water of crystallization being driven from the mortar. This thin layer of dehydrated mortar may have formed a protective coating and prevented dehydration.

"The backs of the brick panels also showed a small increase in temperature, but the natural building stones and tiles proved poorer nonconductors of heat.

"It is apparent that the strength of the webs of ordinary hollow blocks is insufficient to resist the stresses set up in these tests, as in many tests the rapid rise in temperature and the subsequent quenching of one of the faces of the blocks caused the webs to split. It was noticeable that the richer the mortars used in these blocks the better they withstood the tests. The amount of water used in mixing the mortars had a similar effect on the fire-resistive qualities; the mortars mixed with the greatest percentage of water gave the best results.

"When the blocks were cracked or spalled before the application of water the damage appeared to be greater in the dry mixtures containing the greatest percentage of sand, and it was further observed during the fire test that the richer mixtures warmed up more slowly than the others. It is apparent that one of the causes of weakness in the cement hollow building blocks under these fire tests was the weakness of the concrete, a too dry and lean mixture, which, coupled with the thinness of the webs, provided insufficient strength to resist the stress due to the rapid expansion of the face. It is quite possible, as was shown in some of the block tests, to make blocks which will pass the conditions perfectly; the web must be thick enough to give the necessary strength.

"The concrete behaved remarkably well, and it was difficult to determine whether the limestone, granite, gravel or cinder concrete sustained the least damage. The faces of all the panels were more or less pitted by the fire and washed away by the stream of water. The test was unfair to the cinder concrete, as the cinder was very poor, containing a large percentage of unburned coal; however, the sample selected was the best of six or eight investigated in St. Louis. During the fire test the coal ignited and left the surface of the concrete very rough and badly pitted. The limestone aggregate in the face calcined, and the granite aggregate split and broke away from the surface mortar. The granite concrete probably behaved better than any of the above mentioned concretes. Damage in no case extended deeply, probably not more than 1½ inches. The evidence shows that even at this depth the temperature was comparatively low. The high stresses produced in the panels by the rapid rise of the temperatures of the faces, while the backs remained cool, caused cracks. On taking down the panels the blocks of concrete were found to be cracked vertically for some distance from the face. The serious damage done the various natural building stones precludes any comparison among them.

"The tile tested was bought in the open market, and in one panel was taken from a lot of material about to be erected in a building. A large percentage of the faces of the tiles were washed away by the water, and

the material composing the faces became soft and could easily be crumbled in the fingers. There was a comparatively rapid rise in the temperature of the backs of the panels. The plaster on the partition panel tile fell off a few minutes after the test was started."

UNCLE SAM BUILDS POSTOFFICE OF CONCRETE.

Uncle Sam has planned for San Juan, Porto Rico, one of the largest reinforced concrete public buildings in the world. It will be unique, not only for its size, but also for peculiarities of construction. In building for his little brothers in the tropical island our mutual uncle has not ventured to frighten them with such buildings as he erects on his continental domain. James Knox Taylor, supervising architect of the treasury, made a trip to San Juan, and found that the Porto Ricans would be struck in a heap if they had massive doors to swing or much window glass. It was a shock to Mr. Taylor's helpers to dispense with doors and windows altogether, and so they compromised on a row of large windows around the second story. But they did not force the doors upon the sensitive Porto Ricans. And when this big concrete postoffice building is completed the curious of San Juan may go right up to the grill work which takes the place of a door and look in to their heart's content. On the ground floor not even a window glass will trouble their vision.

This peculiarity of construction is made possible by the gentle climate of the island. There is never occasion to keep out the heat, and the wind does not blow so strongly as to seriously interfere with work inside. Had the government authorities undertaken to force heavy doors and mazes of window glass upon the Porto Ricans there is no telling what dire events might not have happened.

But the absence of doors helps towards the end of fireproof construction, and it is certain that this building will be as nearly free from the fire hazard as a building can. The structure will be concrete, strongly reinforced. The greater part of the exterior will show the concrete without decoration. But the ornamental portions of the exterior will be decorated in terra cotta. The walls inside will be finished in brick of various colors. The floors will be of concrete.

The photograph shows that this new building for San Juan will be very impressive and beautiful. It ought to appear very well in concrete, and the fact of the selection of concrete for its construction may open the way to further use of that material in Uncle Sam's building operations in his outlying possessions. Its use at San Juan was dictated not a little by its comparative cheapness. To use granite, marble or sand-stone would have required heavy charges for transportation from this country, as would also the use of any heavy structural steel. Porto Rico is without these building materials. But Mr. Taylor found right at hand an almost unlimited amount of good aggregate for concrete, and it did not take him long to hit upon that as the best material. Through the use of concrete the government will save more than $100,000 on this one building.

The San Juan structure will be about half the size of the United States treasury building at Washington. Its length will be 228 feet and its height 140 feet. The total cost of the building is expected to approximate $400,000. For the construction a sufficient amount is not yet available, and the plans for the building will be held until congress makes a further appropriation.

The building will shelter the courts, postoffice, customs office and other offices connected with the federal administration on the island.

STEAM CURING OF CEMENT TILE.

The ideal conditions for the perfect crystallization of all cement products are moisture and heat, while undergoing this chemical change. Crystallization may be perfected by the aid of steam. The greater the amount of material you can pack in a given space, the more dense or less impervious your product is to water, providing the proper proportions of cement, sand and gravel are used. It behooves us, as producers of cement products, to know we are using a good Portland cement and to so grade our sand and gravel as to fill all voids as nearly as possible. The finer the sand, the greater proportion of cement should be used to make a good product. Too much stress can not be paid to a perfect mixture. In the making of tile, it is necessary that our mixture be semi-wet to enable us to remove the jackets from the tile immediately after they are made.

At our plant, in thirty minutes after the tile is placed on the car, if it is run into the steam room. This room is practically air tight, free from the circulation of air and the sun's direct rays. The room is kept at about 100 deg. F. We say 100 degrees, as that heat will hurry crystallization, and even a greater temperature will do no harm providing the product is properly saturated with water. We never allow to exceed five pounds of steam, preferring a very dense fog with just enough heat to keep the rooms warm. This vapor, as you know, will surround the tile or blocks on all sides, giving to the product the moisture it needs just at the time it needs it most, which is while undergoing crystallization. This treatment, in my judgment, is nearly as good as if the product were made slush in the beginning, a condition which is impossible where jackets must be removed at once. I appreciate that my theory of applying steam to new products is not approved by high authorities, but I reason thus: If the slush system is the most perfect way of making any cement product, the nearer you approach this method the better your product will be. It appeals to me that the sooner this dense vapor, which is water and heat, is allowed to fill the voids of the wall of the tile or block, the better tile or block you will have, if water is an essential.

Our product is treated in this manner for 36 to 48 hours, and during this time no tile is allowed to become gray in color. Over each track we have a line of pipe and every four feet a spray. If for any reason our steam room should become overheated, we turn on the sprays, thus cooling our room and at the same time keeping our products wet. These sprays are also used in watering the products, after they have become sufficiently wet not to wash when water is applied. We work on the theory that it is impossible to give a cement product too much water while it is undergoing crystallization; and yet not enough is given so it will wash.

It is contended by some that a high pressure steam is the ideal condition for proper curing. High pressure steam carries with it less heat than low pressure and will have a tendency to draw moisture from the product rather than to give it moisture.

Some of the advantages of steam curing of cement products are as follows: (1) Every tile is given individual treatment, allowing crystallization to take place under the most favorable conditions, thus making a superior article. (2) Thirty-six to forty-eight hours of steam is equal to fifteen days of air cure, thus allowing you to market your product much sooner than under the air curing. (3) It enables you to perfect a system in your plant. The weather under the steam process need not be considered. (4) Steam curing used with the car system saves one handling of the tile, thus saving labor.—A. B. Elliott, Whiting, Iowa.

HOW THE BLEACHERS WERE MADE DRY.

Every man that has to do with the erection of buildings is interested in the problem of waterproofing, and methods of attaining water-tight structures always receive close attention. With the tremendous vogue of concrete in recent years the necessity of making that material proof against moisture has spurred chemists to produce compounds or washes that will make it impermeable. The remarkable strides made by cement in building projects shows that the one failing that material has—porosity—has been largely overcome by the use of chemical additions to the mix or to the walls or blocks by washes, wax, asphalt applications, etc.

Of the several cement waterproofers, one named Aquabar has won favor with the building public. It has been used successfully in many important works and is daily being used all over the country. Its method of application is simplicity itself, and nothing is left to chance in securing the end for which it is used. It is a paste-like substance that is dissolved in water and thus becomes a component part of the concrete when the water is poured on the cement. By dissolving first there is no chance that it will become a part of the mix, and many virtues are claimed for it after it becomes incorporated with cement.

Some of the claims made for it are that it is not only positive bar to water, but it prevents frost from affecting the blocks or monolith and also prevents chipping or cracking; that it insures steel reinforcement from corrosion; that it is uniform in color, and that the elements do not affect it in any way. One of the strongest claims made for Aquabar is that it does not harm in the least the strength of the cement or concrete.

The simplicity of the mixing is also one of its strong points, as it is put up in two-gallon cans, the right quantity for mixing with one barrel of water. The contents of the can are simply dumped into the water and a long stick used to stir it. After making a few strokes with the stick it is then ready for use as it rapidly dissolves in the water. It does not require skilled labor to mix.

Of the many difficult waterproofing jobs performed by the company that manufactures this material, a notable one was the making moisture-proof the bleachers in the Athletics' ball park in Philadelphia. The bleachers are built entirely of concrete and the problem to overcome was due to the iron supports of the seats. The supports were anchored in the concrete and through the mass. Whenever there was a storm the water soaked into the concrete and ran down the sides of the iron supports, making the space beneath the bleachers a waste of water. This fault was overcome by the use of Aquabar, the only portion of the concrete that was treated being the top coat which averaged about an inch in thickness. The space beneath the bleachers is now so dry and moist proof that the owners of the park are renting it for garages and storage purposes. This work was done recently.

Another very difficult problem which was solved some three years ago was the stopping of the leaks in the intake in the Torresdale filtration plant. Aquabar is now being specified in some of the most important works in this country, the following being a few examples: The Y. M. C. A. Building, Richmond, Va.; Soldiers & Sailors' Memorial, Pittsburg, Pa.; Fort Mason work, San Francisco, Cal.; U. S. Marine Marine Corps, Broad and Washington avenue, Philadelphia; two buildings at League Island; Saint Nicholas Terrace, New York City; Scottish Rights Cathedral; Captain John Young's pier, Atlantic City; Miller & Krause abattoir; tanks and reservoir at Wilmington, Del.; rest pavilion, Atlantic City; Turkish bath, Hotel Ilesworth, Atlantic City; elevator pit, Tenth and Oxford streets, Philadelphia; Gloucester High School; residence of Mr. Shellinger, Cape May; residence of Mr. John W. Barwell, Metuchen, N. J.; Torresdale Conduit Filtration Plant, Philadelphia; German-American Brewing Company, Buffalo; Lubin Palace of Amusement, Philadelphia.

The Aquabar Company, Philadelphia, will be glad to furnish interested parties with the report of Richard K. Meade, the noted chemical engineer and analyst, as to the merits of their waterproofer.

Waterproofed with Aquabar.

SOME RECENT ORDERS SECURED BY POWER AND MINING MACHINERY COMPANY.

The Power & Mining Machinery Company, Cudahy, Wis., advise us that they have secured the following contracts recently:

Eastern Canada Portland Cement Co., Ltd. Quebec. One No. 7½ McCully crusher, one No. 4 McCully crusher one 40″ x 16″ screen, one 25 H. P. boiler and engine, one 20 H. P. boiler and engine, four 8″ x 125″ rotary kilns.

Seaboard Portland Cement Co., Alsen, N. Y., One No. 10 McCully crusher, two No. 6 McCully crushers.

Allentown Portland Cement Co., Allentown, Pa. One No. 10 McCully crusher.

Iowa Portland Cement Co., Des Moines, Ia. One

Mammonth McCully crusher 36" opening, two No. 6 McCully crushers.

CONCERNING THE CEMENT MILLS.

The stockholders of the Great Western Portland Cement Company, of Kansas City, have elected the following directors: J. J. Heim, John W. Wagner, Charles H. Apple, A. H. Glasner, Charles D. Rule, David Goerz, E. C. Hepler, Cusil Lechtman and Edward Leopold.

At a recent meeting of the Arkansas City Portland Cement Company, the following officers were elected: President, C. C. Stranghan; vice-president, F. Trimper; treasurer, John E. Heard; secretary, Vanton O. Foulk. The offices of the company are in the Solitt and Swarts building, Arkansas City, Kan.

Wm. Klekner has been appointed superintendent of the New Castle Portland Cement Company, New Castle, Pa. Mr. Kleckner was formerly employed by the Pennsylvania Cement Company, Bath, Pa. Prior to his connection with the Pennsylvania company he was in the employ of the Nazareth Cement Company.

C. H. Sonntag, formerly chief chemist of the Kansas City Portland Cement Company, has been appointed chemist of the Great Western Portland Cement Company, at Mildred, Kan.

Harry E. Mick, late chemist of the Western Portland Cement Company plant at Yankton, S. D., has accepted the position of chemist with the German-American Portland Cement Company at La Salle, Ill. Mr. Mick expects to take a position with the projected Portland cement plant at Chamberlain, S. D., as soon as that project has matured.

Joseph Brobston has been appointed secretary and treasurer of the Northampton Portland Cement Company, Stockertown, Pa. He also retains his connection with the Dexter Portland Cement Company. J. A. Setz takes charge of the sales department with offices in the City Investing building, New York City.

Chas. L. Johnson has become associated with one of the western plants of the Cowham System. He was formerly secretary and sales manager of the Castalia Portland Cement Company, Sandusky, Ohio.

Amos Kendall, Jr., has resigned from the Wolverine Portland Cement Company, Coldwater, Mich., to rejoin the Omega Portland Cement Company, Jonesville, Mich.

O. K. Baker has resigned as superintendent of the United States Portland Cement Company, Yocemento, Kans.

M. M. Ludlow, formerly connected with the Northwestern States Portland Cement Company as assistant chemist, has been appointed chemist for the Southwestern States Portland Cement Company of Dallas, Texas.

Mr. A. Morgan, formerly connected with the Peninsular Cement Company at Jackson, Mich., has accepted a responsible position with the Dixie Portland Cement Company of Copenhagen, Tenn.

Mr. Cullingan, president of the Alpena Portland Cement Company, is making an inspection tour of a number of cement works in preparation for the remodeling work which his company soon expects to take up.

The Allentown Portland Cement Company, of Allentown, Pa., with works at Evansville, recently absorbed the Vidax Company, at Molltown, also on the Reading Railway's Schuylkill and Lehigh branch.

At a meeting of the directors of the Alpha Portland Cement Company at the offices in Easton, Pa., A. F. Gerstell was elected president of the company, to succeed the late W. M. McKelvey, of Pittsburg. J. M. Lockhart, of Pittsburg, was elected vice-president, and G. S. Brown, of this city, was appointed to the vacant place on the executive committee.

MASON CITY, IOWA.—The Lehigh Cement company closed options on 720 acres of land north of the city paying $60,000 for the same. This assures the plant for this city, which will cost $2,500,000.

The following is the new list of officers and directors as a result of the annual meeting of the Panama Portland Cement and Development Company, Batavia, N. Y.:

President—Chas. R. DeMoney, Buffalo, N. Y.
Vice-President—James G. R. Cole, Buffalo, N. Y.
Secretary—C. C. Godfrey, Batavia, N. Y.
Treasurer—C. Orvis Brown, Batavia, N. Y.

The above and the following are the directors: Ralph C. Lupten of Wilmington, Del.; Samuel Landauer, Medina, N. Y., and Nelson R. Hand, Medina, N. Y.

The Mississippi Valley Cement Company, of Louisiana, Mo., has filed a mortgage deed of trust to the Mississippi Valley Trust Company of St. Louis, to secure bonds in the sum of $1,500,000 which will be issued to raise money to pay off its indebtedness and to complete the plant in Louisiana. The bonds will run until July 1, 1929, but are redeemable in 1912, and will draw 5 per cent interest.

Preparations are being made by the Crescent Portland Cement Company to place its new plant at Wampum, Pa., in operation by July 1, and the indications are that the company will be making cement in the new department by that date.

The plant is equipped with six kilns, rated at 600 barrels per day each. The machinery has been placed, and is being tested, all of which is working satisfactorily.

The Sun Portland Cement Company of Owen Sound, Ontario, has secured options on large rock deposits on the shore of Georgian Bay at a short distance from its works. The rock is of first class quality for the manufacture of Portland cement.

This company has manufactured its product from marl in the past, but it is planned to make a change to rock and to increase the capacity of the plant materially.

The directors of the Castalia Portland Cement Company, meeting at Pittsburg, voted $60,000 for improvements at the Castalia plant, in order that the output may be increased 20,000 barrels a month. Albert Andrews, of Toledo, Ohio, has assumed his duties as sales manager.

PLANT FOR MEXICO.

F. A. Losh of Santa Clara, Cal., and associates are arranging to establish a cement manufacturing plant in Mexico at a cost of about $1,000,000. Mr. Losh has been investigating the different cement beds of the country and has found a number of localities where the plant could be established under unusually good advantages. He expressed the opinion during a visit to this city that the price of cement in Mexico is much higher than it should be and that a good profit could be made out of the industry if the prices were cut in two. It is probable that the proposed plant will be located in the vicinity of Mexico City.

LEXINGTON, KY.—The Continental Artificial Stone & Manufacturing Company, incorporated, started their plant in operation on June 1.

A. Traliot, of Lexington, is president and general manager of the company; A. K. Haynes is secretary, and Messrs. J. H. Boston, H. H. Jones and T. B. Tracy are directors.

Lexington will be headquarters for the company, but agencies will be later established in various other cities.

PLANT WELL UNDER WAY.

Bozeman, Mont.—Reports received here from Three Forks say that work on the construction of the cement plant at Trident is well under way. The plant will be about forty miles from Bozeman and is being built by the Three Forks Cement Company. Vreeland & Cain, of Bozeman, have charge of the work. It is expected that the plant will have capacity of 1,800 barrels a day.

NEW CEMENT MILL IN VENEZUELA.

Minister William W. Russell reports from Caracas that the National Cement Factory was officially opened recently in the capital of Venezuela. The company is a native one, with a capital of 626,000 bolivars (bolivar equals 19.3 cents). The material for manufacturing the cement is obtained on the site of the factory. Portland cement has been imported into Venezuela in barrels of 170 kilos and sold at 22 and 24 bolivars per barrel. The cement from the new factory is sold in barrels of 170 kilos (375 pounds) for 16.5 bolivars per barrel, and to the government at 14.5 bolivars per barrel. From the proofs at the factory, the new cement is stated to be as good as the imported article.

PENN-ALLEN COMPANY AS HOSTS.

President W. P. Dallett of the Engineers' Club, of Philadelphia, recently headed a large delegation of the members of the junior branch of that organization on a visit of inspection to the Penn-Allen Portland Cement Company, near Bath, Pa., in order that they might see how cement is manufactured in a modern plant.

From the Reading Terminal the trip was made over the North Penn Railroad in a special car attached to the Black Diamond. A box lunch from Boothby's was served on the train. At Bethlehem the party boarded a special train on the Lehigh & New England Railroad, which ran direct to Penn Allen, under the escort of representatives of the Penn Allen Portland Cement Company.

The visitors were escorted through the plant by General Manager William E. Erdell, Sales Agent S. G. K. Stradley, Superintendent E. A. Wolf and Chemist Joseph H. Sigman. From the engine room they went to the quarries and then saw the crushing, burning and grinding, winding up in the stock houses, where they saw the cement placed automatically in bags by the Bates valve bag machine, and then shipped by the trainload out of the works. The plant, which is running in full blast, is a model one for its capacity of 2,200 to 2,500 barrels a day, in design, operation and output, and all the visitors were highly pleased with the instruction gained by the inspection.

LUMBER SHEDS OF CONCRETE.

The Jewett Lumber Company, Des Moines, Ia., have recently completed a concrete shed at its east side plant. In the construction of the building 1,000 barrels of cement were used and its cost was about $10,000. Its capacity is about 60,000 feet of lumber. The shed is a three-decker, the piles of the lower bins resting on independent foundations, and not only are the walls concrete, but the posts, 8x8 inches, the girders 8x12 inches, and the floors of the office, 24x28 feet, and the hardware room, 22x40 feet, are of the same material.

The cement wareroom, 22x50 feet, has a 5-inch floor, supported by heavy concrete columns, and is supposed to be able to sustain any weight that may be placed on it. The walls were built lying flat on the ground and then elevated into place. One of the walls, 4½ inches thick, weighed ninety tons.

George A. Jewett is the president of this company; W. A. Lawrenson, secretary, and W. O. Sloan has the management of the yard.

ACME PORTLAND CEMENT PLANT.

A 1500 barrel Portland cement plant is to be erected by the Acme Portland Cement Co., on the outskirts of the City of Spokane, Wash. The grounds have been examined thoroughly by Dr. W. Michaelis Jr. of Chicago and have been declared to contain an inexhaustible supply of the best and most uniform cement material. Dr. Michaelis also burnt the first Portland cement from the materials which proved to be equal to the best Portland cements on the market. The raw material properties had been examined several times before by various parties who were undecided about the quality of the material. For this reason Dr. Michaelis was called upon as highest authority to go over the properties once more and to submit a detailed report, as the owners of the properties knew the value of his reports, and their influence upon capitalists. Michaelis succeeded in this case in the same way as during several previous investigations, in finding better materials than were supposed to be on the grounds. This was due to a superior knowledge of the geological formations, which determined the investigator to look for the right cement materials at places at which former examiners thought it useless to take samples. The thorough and splendid way in which Dr. Michaelis' reports are gotten up likewise can not fail to make a favorable impression upon the reader. A New York banking firm is now raising the money on the strength of Dr. Michaelis' report. This is the third time that Michaelis has been employed by large concerns in the West for the purpose of examining cement material properties. In every instance he surpassed the expectations of the owners by locating better materials than were believed to be present.

CEMENT FOR JAMAICA.

Consul Frederick Van Dyne reports that with the extensive rebuilding operations now going on in Kingston and the increasing popularity of concrete construction throughout Jamaica, a promising field for American cement has been opening up, as the following indicates:

This condition is favored by the action of the legislative council in amending the local tariff law so as to place Portland cement on the Freelist. During the fiscal year 1906 there were only 81 barrels of cement exported from the United States to Jamaica. In 1907 the American exports aggregated 7,742 barrels. The total imports of cement for the fiscal year 1908 were 72,849 barrels.

The great bulk of this trade is with England, but with the much shorter distance and consequently lower freight charges the advantage is greatly in favor of the United States. The rapid increase in sales of this product has induced British companies to send their agents to Jamaica to endeavor to retain the trade, and in at least one case the manufacturer himself has come to Jamaica.

Excellent pioneer work has been done here in the way of introducing American cement, and the trade has been successfully initiated. Unless it is followed up, however, by sending experienced American agents to Jamaica to advertise and push sales, the advantages gained will be lost.

COST OF MODERATE PRICED DWELLING HOUSES OF RE-INFORCED CONCRETE.

So much has been said regarding the cost of moderate priced dwelling houses of reinforced concrete that an estimate has been made on four of the prize designs of the competition held by the Association of American Portland Cement Manufacturers. These have been figured out on average unit costs determined by the writers experience. First prize was for a two thousand dollar house single and double, and for a forty-five hundred dollar house single and double. The first figure is for a house as designed by the successful competitor, the second figure for a distinctly monolithic fireproof house on the same design. It will be seen that these houses cost much more when estimate is based upon experience herein before referred to than when figured as given in the competition. It is nevertheless the writer's opinion that small detached houses cannot be built as cheap as a rule as the average unit price upon which the estimate is based because these unit prices are obtained from much larger buildings, the majority of which are much plainer in design, which thereby simplifies the construction.

There has been some inquiry regarding the cost of workmen's cottages and a design has been made for a block house to be built in not less than twenty at one time in blocks of ten or more in length. These are two story houses with cellar for storage of coal, two rooms on the first floor four chambers and toilet on the second: 17 feet front, 27 feet deep, fireproof throughout. These could be built for sixteen hundred dollars each, or 16.9 cents per cu. ft. and $1.73 per sq. ft. of floor space. If built of the same design only of wood, the cost is estimated to be $1.355, or 14½ cents a cu. ft., $1.48 a sq. ft., a saving between concrete and wood of $245 or 15.3 per cent. Considering the severe wear and tear such a house receives from the class of people who occupy it, this difference in price is very well justified. Prices given here are for everythng neccessary, for the bulding complete, ready for immediate occupancy.

Cost of four houses, prize designs from the competition held by the Association of American Portland Cement Manufacturers.

(The houses are complete except for heating, lighting and plumbing. The third column is figured out by unit costs given in the preceding tables for a house with concrete walls and wooden interior as per the competition; the fourth column is for the same house built entirely fireproof.)

	Limit in the Comp'tion	Cost as per Competition	Cost all Fireproof
No. 158, Eugene Ward, Jr., Archt., Single house, 26′ front x 29′ 8″ deep; 2 stories and cellar; 4 rooms and bath.	$2000.	$3694.	$431
No. 177, Andrew Lindsay, Archt., Double house, 66′ 6″ front x 28′ deep; 1½ stories and ½ cellar; 4 rooms and bath.	4000.	6716.	3385.
No. 156, Eugene Ward, Jr., Archt., Double house, 72′ 8″ front x 30′ 10″ deep; 2½ stories and cellar; 8 rooms and bath.	9000.	10440.	12507.
No. 96, W. Cornell Appleton, Archt., Single house, 33′ front x 28′ deep; 2 stories and cellar; 7 rooms and bath.	4500.	5847.	7112.

RELATIONS OF TEMPERATURE TO TIME OF SET AND STRENGTH OF CONCRETE.

The text books have plenty to say regarding the time required by concrete to set under normal temperatures, but very little indeed as to the conditions when the temperatures vary. In a word little has been published which bears directly upon the builders problem of determining how long to leave centres under concrete.

To assist in providing some definite information regarding this subject the Aberthaw Construction Company of Boston, Mass., through the courtesy of the Quincy Market Cold Storage Warehouse Company and with the assistance of Mr. H. L. Sherman, cement chemist, both also of the same city, have undertaken a series of tests under controllable temperature conditions. Publicity has already been given to some of the results covering a relatively short period.. In the following table are now given the results at the end of three months.

Temperature of air and materials	Mixture	Average tensile strength in lbs. per. sq. in. at the end of 3 months
72°	Neat	759
	1:3	305
41°	Neat	660
	1:3	303
34°	Neat	567
	1:3	249
41° (room,-7°)	Neat	29
	1:3	9

It will be noted that at a temperature of 72°, the cement showed a decrease in strength from 7 days to 28 days on the neat tests, while on the mortar tests the strength was the same. On the tests at 41°, there was a good increase between these periods on both sand and neat tests, and at 34° a better percentage increase on both. In the opinion of the chemist this is an illustration of the importance of water on the early strength of cement. At 72°, the excess water contained in the briquettes was evaporated rather quickly, while at the lower temperatures, the rate of evaporation was very slow. Between 28 days and 3 months, the briquettes at 72° showed a very good increase, those at 41° a less decided increase, and those at 34° still less. Apparently cement at low temperature (above freezing, however) attains less strength than at a normal temperature but its increase in strength in short times is greater.

It is interesting to note that the cement kept at the very low temperatures, finally set and attained a very little strength. It would be interesting to discover whether there would be an increase in strength at later times.

CEMENT KILN ECONOMIES.

The writer believes that there is, at the present stage of cement production, a great deal of room still existing for effecting perfect operation and economies in rotary cement kilns. Among these might be mentioned the proper proportioning of the dust chamber to give perfect draft and minimum droppage of raw material, the reduction of the flue gas temperatures, the proper combustion of the powdered coal, the advantage or disadvantage of low pressure air over high pressure air, the reduction or utilization of the waste heat due to radiation.

Very little progress has been made toward improving economies in cement kilns since the acquisition of the Hurry and Seaman patents on coal burning, and the patents of Edison on long kilns by the North American Portland Cement Company. This is probably due to the rapid strides cement production has made within the past three or four years, when orders had to be filled, and improvements in plant or machinery were treated as a secondary consideration or left to the manufacturer. As competition becomes keener, with the price of the finished product down to the bottom notch, every cement mill owner will find it very important to effect every possible economy, no mattter how insignificant it may be by itself, because in the aggregate it means dollars and sound financial standing.

I would not attempt to cover the whole subject above

referred to here, as each of the above questions beyond doubt requires a different solution for different climatic conditions and manner of operation, but I want to point out briefly some of the possible losses in energy due to radiation. I have given some comparative figures, and the possible economies on the heat losses on the external surface of rotary kilns.

First, with bare kilns as in operation today.

Second, with the outside surface covered with 1¼-inch 85 per cent magnesia.

While I am fully conscious of the fact that the question of covering the outside surface of the kiln will be subject to a varying opinion, from mills which determine the condition of the kiln lining by so-called "hot spots," I believe it is possible to entirely avoid such "hot spots" or the burning through of the lining in properly operated and maintained kilns. Rotary kilns should be regularly inspected and maintained systematically, as any other piece of machinery, and should not be operated continually until the lining has completely burned through, thereby allowing the shell to become excessively heated, and causing the latter to buckle and in time ruin the entire kiln.

If the heat is properly applied, and the kiln is properly operated "hot spots" and "ringing up" will entirely disappear. Fire brick lining in kilns is good for a definite amount of clinker, and when this amount is exceeded by trying to effect a small additional amount of clinker it is done to the detriment of the shell and is money lost in the long run.

I have assumed here for illustration a kiln and temperature of the following values:

Diameter of kiln, 7.5 feet.
Length of kiln, 120 feet.
Total exposed surface in square feet, 2,838.
Temperature of surrounding air, 70° F.
Temperature of kiln surface, 290° F.
B. T. U. per sq. ft. per hour per degree difference in temperature (bare), 2.76.
B. T. U. per sq. ft. per hour per degree difference in temperature (covered), .384.

Then we have:

Total B. T. U. loss per hour: $2.76 \times 220 \times 2{,}838 = 1{,}722{,}600$.

With coal at 13,000 B. T. U. per lb. we have an equivalent of 133 lbs. of coal per hour consumed as waste heat, and further assuming coal at $2.25 per gross ton, we have:

$$\frac{133 \times 22 \times \$2.25}{2{,}240} = \$3.03 \text{ per day loss.}$$

In other words, every day the kiln is in operation the loss incurred due to radiation equals $3.03 waste.

Now, suppose a plant operating, say, twelve such kilns, which is equal to approximately 6,000 barrels daily capacity; the average temperature of the surrounding air would be considerably higher, say, 120°; in turn, the kilns would also be somewhat hotter, say 320°. Then we have

Total B. T. U. loss per hour, $2.76 \times 200 \times 2{,}838 \times 12 = 18{,}798{,}900$, which would equal (with coal as above), 12.4 tons per day, and assuming the cost of the coal at $2.25 per ton as above we have $12.4 \times 2.25 = \$27.90$ per day, loss, or $10,183.50 per year.

Now, for the sake of demonstrating the possibility of what economy could be effected in this last case, let us assume that the entire kiln surface was covered with 1¼ inches 85 per cent magnesia covering. Then we would have as a loss in the 12 kilns as follows:

Total B. T. U. loss per hour, $.384 \times 200 \times 2{,}838 \times 12 = 2{,}616{,}636$, which would be equal to (with coal as above) 1.9 tons per day or $1.9 \times 2.25 = \$4.27$ loss per day, or a loss per year of $4.27 \times 365 = \$1{,}558.55$.

In other words, by such a covering a saving per year can be effected of $10,183.50—$1,558.55—=$8,624.95, which will pay 5 per cent interest on $173,000.

The above figures and constants are based upon an average condition and further experiments should be made, as they will no doubt vary in different localities (such as cost of coal, temperatures, etc.). They do, however, open up an important question with a very fertile field for investigation.

NEW BOOKS.

Mr. H. G. Tyrrell, civil engineer, 1847 Asbury ave., Evanston, Ill., has published a Hand Book on concrete bridges and structure, size 4114x6½ inches, and contains 128 pages and 51 illustrations. It is printed on a fine quality of heavy glazed paper, with gilt edges, and bound in black flexible leather covers. Price $2.50.

Part 1 treats of Concrete Bridges for both Highways and Railroads. It gives in a concise manner the most approved methods of design and construction and puts the information in such a practical form, that the busy engineer can easily apply these methods of design, without spending valuable time in the perusal and study of abstruse mathematical treatises.

Part 2 contains methods of design and construction for minor bridges and structures, including trestle bridges and culverts.

He has also published a pamphlet describing the new steel bridge on the Miami River at Elizabeth, Ohio, being a remarkable bridge; the longest Pratt Truss Bridge span in existance. It has a length of 586 feet and exceeds the next longest span by 36 feet.

The pamphlet contains 24 pages, and five pages of illustrations. It is 6x9 inches in size and is printed on a fine quality of glazed paper. Price 50 cents.

Ernest McCulloch, C. E., has a new book on the market by the Myron C. Clark Publishing Company, 355 Dearborn street, Chicago, entitled, Engineering Work in Towns and Cities. 510 pages, 6x9 inches and is finely illustrated. Price three dollars.

This is a very instructive treatise covering the planning and execution of municipal improvement, and is designed to assist city engineers and other public officers concerned in and with such improvements.

The author's aims has been to explain clearly and in simple language the best methods for the economic carrying out almost every kind of public work, required in town and cities, such road and street improvement, sidewalks, curb and gutter constructions, drainage and sewer work, water supply, concrete construction, materials, use and methods of testing, standard specifications, and ordinances, relating to the various kinds of work required in public improvement, city engineers records, field work, and engineering data, all systematically arranged and thoroughly indexed. The clear and concrete style in which the matter is presented free from technical terms make the book valuable to newly elected public officers who are compelled to deal with municipal improvement, through and under ordinances calling for the same and in the supervision and execution of the work with which they are charged.

We congratulate Mr. McCullough on the sound and logical and economical methods advocated in the planning and execution of public works presented in this treatise. The book should be on the desk of every city official and contractor concerned in making public improvements.

A handsome 48 page illustrated pamphlet, published and distributed by the Portland Cement Co. of Denver, Colo., entitled Concrete Buildings and Constructions was recently issued.

It was brought out to show the utility of concrete construction during the discussion which followed the appointment of a committee by the Mayor of Denver, to modify the city building laws. It contains much valuable data on the subject of Concrete Construction and especially on the subject of Concrete Sewer Pipe. Send for a copy.

IMPROVED DUST-COLLECTING SYSTEM FOR CEMENT MILLS.

One of the most perplexing questions which the cement manufacturer has had to solve is that of dust. The large amount of dust which is bound to fill the air about a cement plant, unless steps are taken for its removal, is a disadvantage in more ways than one. In the first place, it is an expensive waste of cement, and in the second place, by setting into the bearings of costly machinery, it adds greatly to the wear and tear and materially shortens its life.

The large percentage of the flour of cement that is lost is an item which all manufacturers will be obliged to consider carefully as competition increases and the margin of profits diminishes. This cement, which flies away in the atmosphere, is the very best part of the product. It is the finely ground cement which manufacturers spend millions of dollars in expensive grinding machinery to produce. The dust also puts the plant in a condition well calculated to drive away the best employees, who cannot and will not do their work to advantage when the lung-choking and man-killing dust is floating around everywhere. Do away with the dust and a better class of workmen can be employed.

It has remained for the Prinz & Rau Manufacturing Company, of Milwaukee, Wis., to solve this problem and to successfully produce a system that is reliable and practical. To explain this in detail it will be well to describe the system lately installed in the plant of the Newaygo Portland Cement Company, Newaygo, Mich., under the personal supervision of W. G. Clark, 415 La Salle avenue, Chicago, an expert on dust collecting systems, and Chicago representative of the Prinz & Rau Company.

Briefly described this system consists of a specially designed main wind trunk which is self cleaning, there being no possibility for dust to lodge in it, an objection that has never been solved until now. The same is true of all the suction pipes tributary to the main wind trunk. The advantage of this is self-evident, for with clean air pipes, the uniformity and effectiveness of work is assured. Again, in order to settle the heaviest of material the main wind trunk is so designed as to secure this result, also the specially designed settling chamber, built of galvanized iron, with air brakes that cause a large percentage of the heaviest part of the dust to settle therein.

BIG CEMENT PLANT PLANNED.

Poughskeepsie, N. Y.—The American Cement Company has closed a contract for the erection of a million dollar plant in this city, for the manufacture of Portland cement. They have purchased thirteen acres of land near the New York Central railroad. Work is to be commenced at once.

The Seymour Concrete Company, Seymour, Conn., has been incorporated by Franklin Farrel, Ansonia; Amos W. Morris, Seymour, and Robert Stanzel, Seymour.

VALUABLE BOOKLET FREE.

"The Hess Warming & Ventilating Co., 919 Tacoma Bldg., Chicago, have just issued a new edition of their handsome booklet "Modern Furnace Heating," which, in completeness and in high quality of printer's work, excels anything ever published by this company.

The booklet forms a complete handbook on furnace heating, and contains much information of value to every house builder or owner. It covers forty-eight pages, beautifully printed in two colors, on fine enameled paper. The cover is handsomely embossed, in two colors; and the booklet, as a whole, is most attractive and well worthy of preservation. The Hess Company,

whose advertisement appears on another page, are large manufacturers of steel furnaces, selling directly to consumers and not through dealers.

They invite correspondence from all who contemplate using hot air furnaces, and offer most unusual terms of trial, besides a lower price on furnaces and fittings than any dealer can afford to quote. The new booklet is free on application; and a copy will be sent to every one requesting it.

A TREATISE ON KILNS.

Ernest Schmatolla, a German engineer who has recently come to America and located at 150 Nassau street, New York City, is the author of several treatises on kilns for Portland cement and other materials. His most recent work, which deals more particularly with the use of gas for fuel in kilns, is written in German, but a translated edition is in preparation.

Mr. Schmatolla's work, for those who read German, will be found of much interest, since his studies of the

ubject of kiln construction and firing has been unusu-lly thorough and his book represents the most modern practice in these regards. It is fully illustrated, with 50 plates, showing in detail the construction of various ypes of kiln.

Chapters on the use of gas for fuel will have a special nterest for the men engaged in superintending the work or burning cementitious material. And since so many of ur best chemists in Portland cement plants have enoyed the advantages of training in German, Mr. Schmaolla's book should be of value to them.

AN ECONOMICAL CONCRETE MIXER.

The U. S. Steel Mixer Company, Atwood Building, Chicago, have placed on the market a portable cube batch mixer which is drawn by two horses. A cut of which we present herewith. This machine is a great saving to any contractor as the raw materials are loaded directly into the machine and are mixed while being drawn to place.

The mixing cube makes eleven complete revolutions every 102 feet of travel, thus turning material 33 times in that distance. The mixed concrete is then dumped in place; dumping is accomplished by opening door of cube and using dumping lever. The measure materials may be fed into machine in any order.

The general construction of the machine consists of two wheels, an axle and frame upon which is mounted two standards which carry and support the mixing cube and water tank. The power is transmitted from the two drive wheels which rest upon the ground, to two gears mounted upon the axle. These two gears engage two other gears which are keyed to the hollow-journalled bearings on mixing cube. The machine can be thrown in and out of gear at the will of the driver. A tongue carrying double trees and tongue chains extending from the forepart of frame, beneath which is mounted a wheel to carry weight of tongue and double trees. The necessary water is fed from tank, through a perforated pipe into mixing cube and is under perfect control of the driver at all times.

This is the best concrete mixer on the market today and is a money maker for any contractor. They cost about ¼ of the other mixers and are more simple and economical. It is the invention of Mr. S. N. Cornwall, a well known contractor of Sheridan, Wyoming where a great many of them are in use.

The Henry C. Grieme Company has been incorporated at Amsterdam, N. Y., to manufacture brick, stone and building material. Capital stock, $135,000. Incorporators: M. Grieme, M. M. Miles and A. C. Le Hahn.

New Cornwall Mixer.

CONCRETE BEAM TEST.

In Bulletin No. 28, issued by the Engineering Experiment Station of the University of Illinois, Prof. Arthur N. Talbot describes some unique, practical tests on large floor slabs for use in the Grand Crossing track elevation of the Illinois Central Railroad. This is perhaps one of the most important reinforced concrete constructions of the kind yet undertaken, and it gave an opportunity for making field tests to determine the strength of larger pieces of concrete made under practical conditions. The beams weighed 33 tons apiece, probably the largest reinforced concrete beams ever tested, and the testing apparatus used and the method of making the tests involved some novel features. The beams carried loads of 340,000 lbs. The tests determined the effectiveness of two methods of placing reinforcement to resist shear failure. The results will be of interest also because the beams were chosen almost at random from a large number of beams made up for use in a railroad structure. There has been a feeling among engineers that test beams made up in laboratories differ so much in make-up from the work found in reinforced-concrete construction that the results of laboratory tests may not be considered to be applicable to actual construction. The tests, however, indicate that the action and properties of reinforced-concrete beams made under careful supervision under the ordinary conditions of construction do not differ much from those of laboratory test beams. Owls Portland cement was used.

IMPORTS OF CEMENT INTO THE UNITED STATES.

WHERE FROM	MAY				ELEVEN MONTHS ENDING MAY			
	1908		1909		1908		1909	
	Quantity in lbs.	Value in Dollars.	Quantity in lbs.	Value in Dollars.	Quantity in lbs.	Value in Dollars.	Quantity in lbs.	Value in Dollars.
United Kingdom . .	6,690,780	$24,083	,600	$121	175,756,535	$653,606	22,250,126	$72,616
Belgium	1,103,580	2,902	. . . .	. . . .	143,267,732	455,112	49,305,535	164,587
France	297,600	1,276	1,497,805	5,251	11,403,527	43,879	18,327,196	73,563
Germany	3,012,265	11,105	752,173	2,842	210,960,364	698,670	71,425,629	263,985
All Other Europe .	. . . .	. . . .	. . . .	. . . .	3,891,128	13,465	510,935	1,543
British North Am. .	1,750	15	991,900	4,944	278,290	1,643	15,815,270	80,397
Other Countries . .	2,600	30	20,340	89	5,709,547	30,110	839,687	3,505
TOTAL	11,108,575	39,411	3,295,818	13,247	551,267,123	1,896,485	178,474,378	660,186
Domestic Exports of Cement, bbls. . . .	83,016	131,259	76,164	100,862	860,431	1,345,336	722,235	1,003,073

There were 21,480,415 lbs. of imported Roman and Portland Cement, etc., in the United States bonded warehouses in May, 1908, valued at $82,914, against 8,555,466 lbs. in May, 1909, valued at $18,993.

For eleven months ending in May, 1908, there were 118,937 tons of asphaltum imported in the United States valued at $464,636, against 119,696 tons imported in eleven months ending May, 1909, valued at $567,454.

The Cornwall Portable Cube Mixer

IT IS DRAWN BY TWO HORSES. THE RAW MATERIALS ARE LOADED DIRECTLY IN THE MACHINE AND THE MATERIALS ARE MIXED WHILE BEING DRAWN TO PLACE.

Will increase the output of each man's work 100%.

It's the result of each man's labor that counts in the day's work.

The Cornwall Portable Cube Mixer is a high class mixer, simply and strongly made and is designed by a practical concrete contractor. The mixing receptacle is a Cube which turns, throws and kneads all the raw materials together constantly giving the maximum strength to the materials.

The exclusive and original construction of our machine makes the time spent in mixing less than with any other machine.

Our methods of gauging materials and water are absolutely correct.

It has the greatest output per man of any machine ever made.

Write us before you buy.

The U. S. Steel Mixer Company, Inc.

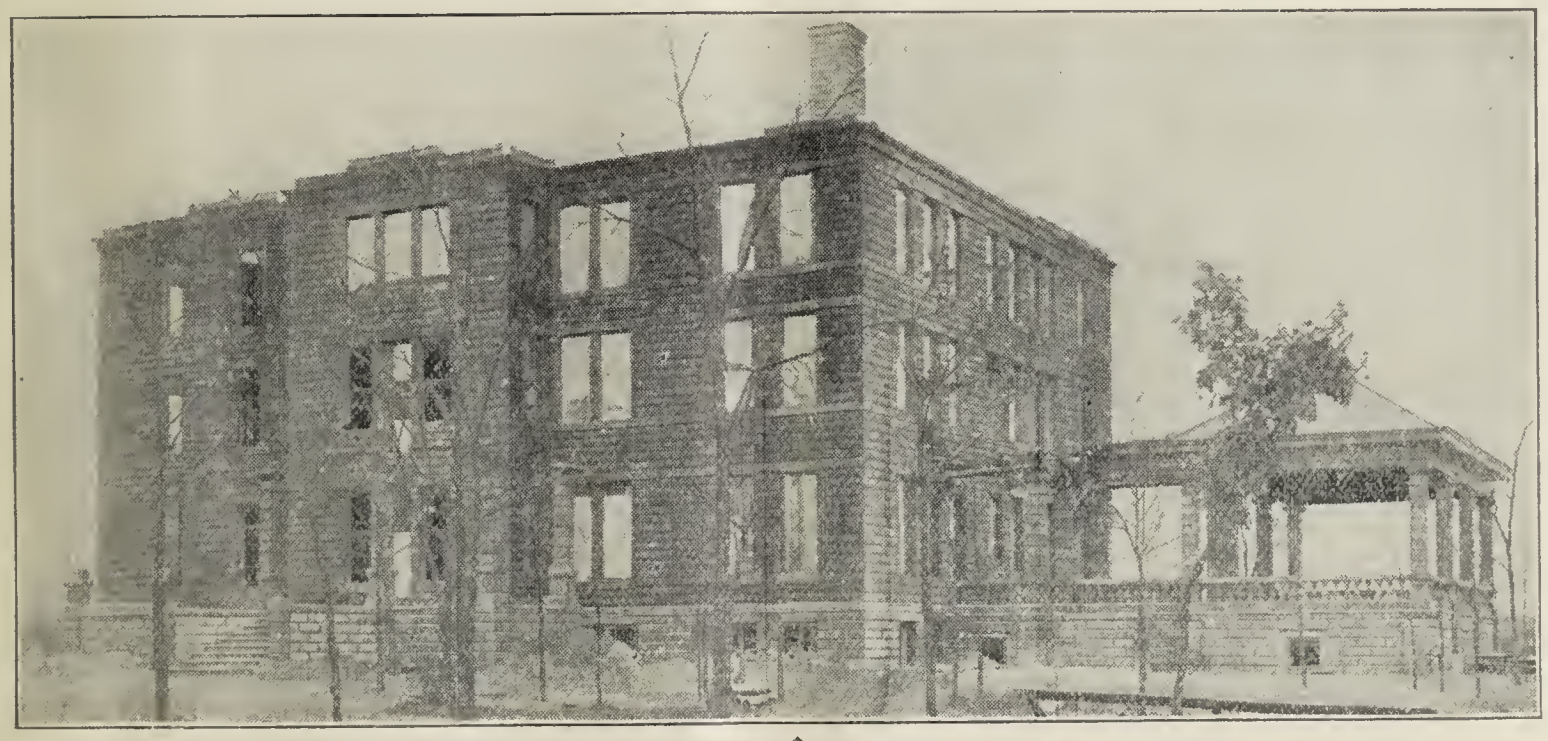
630 Atwood Bldg., Chicago, Ill.

CEMENT

.....AND.....

ENGINEERING NEWS

Aug. 1909



After fire, nothing left but walls of Concrete Blocks

THIS BUILDING WAS IMMEDIATELY REBUILT AS THE WALLS WERE IN FINE CONDITION. THE CONCRETE BLOCKS WERE MANUFACTURED OF COURSE AGGREGATE MIXED WET MADE BY THE CENTURY MACHINE COMPANY OF ROCHESTER, N. Y.

CEMENT AND ENGINEERING NEWS

[PUBLISHED MONTHLY]

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JOHN F. WALDRON - - - - Advertising Manager

CHICAGO, AUGUST, 1909.

PORTLAND CEMENT THE BEST FIRE-PROOFING.

There is no such thing as an absolutely fireproof building material that will be proof against high temperatures. Even asbestos is only fire-resisting to a degree. While asbestos will retain its form under the action of high temperatures, yet it will in time absorb the same temperature to which it is being subjected. It will radiate just as much light and heat as any other material substance at the same temperature following the universal law that all bodies radiate the same amount of light and heat at like temperatures.

In order to produce or select a material or compound that will best resist the penetration of high temperature. This can be accomplished by giving the high temperature work to do, by temporarily changing the chemical composition of the substance or compound, or by expelling moisture. For instance during the summer season street railway tracks are sprinkled with water to prevent the expansion of the rails, the sun's heat being given work to do in evaporating the water sprinkled upon the tracks. While this evaporation continues the expansion of the rails is reduced to a minimum.

Portland Cement Concrete is one of the most valuable fire-resisting materials used in building construction, from the fact that the water with which the cement is gauged unites with the cement and forms a solid known as the water of crystallization. This compound unites with the cement and forms a hydrate.

This union of water with cement produces a valuable fire-resisting building material because the water of crystallization must first be decomposed before the heat can penetrate the mass of which it forms a part.

Take for example a concrete building block and subject it to a high temperature. The block will not heat through at once, but before the heat can penetrate into the block, the water of crystallization must be driven off, thus the heat has work to do in decomposing the water of crystallization. This passes off as vapor or steam and while the outer layer of the block be red hot there will be a cooling action at work just back of the incandescent surface undergoing decomposition, forming steam which passes off through the incandescent surface. This keeps the temperature down and prevents the block from heating through, as there is always a layer back of the incandescent surface. Concrete blocks can only take on the high temperature by which it is surrounded after all the water crystallization has been expelled. This property of resisting the penetration of heat is not possessed by brick, terra cotta or stone. These last named building materials will therefore heat through much quicker than concrete. After a concrete block has been deprived of all its water of crystallization it is reduced to the same rank and grade as brick and sandstone. Concrete, however, possesses the property, after cooling, of recuperating and again taking on its condition and strength, by gradually absorbing moisture from the atmosphere and thereby regain its water of crystallization and will be ready for another siege of high temperature.

MAKING DURABLE ROADS.

The use of reinforced concrete or "ferro-cement" roads has been suggested in France, and this style of pavement has stood a trial in a testing machine well indeed. Great things are predicted of it in Cosmos, as may be seen by the following excerpts:

"It has been attempted to incorporate with paving materials various hard or resisting substances, such as crushed glass, corundum, and carborundum. An inventor has now devised a new combination—cement and 'iron straw.' This substance is made by the entanglement of fine metallic shavings, and ordinarily appears in the form of masses, blocks, or sheets, more or less compact, offering great resistance to separation, owing to the kind of felting resulting from the entanglement of the constituent threads or shavings, and also offering a certain amount of elasticity to compression. To make a slab or block of ferro-cement a mass of iron straw is placed in the mold, and there is poured over it cement sufficiently fluid to penetrate into all the interstices of the iron and completely cover it. When all has set the core of iron, thus intimately incorporated, gives to the block a great resistance to breakage and to traction, at the same time furnishing elasticity to compression which enables it to stand superficial shocks.

"A brick of ferro-cement four centimeters (one and three-fifths inches) thick has supported during crushing tests a pressure of 10,000 kilograms to the square centimeter (about sixty-five tons to the square inch). In breakage tests the resistance was quadruple that of ordinary cement. Resistance to wear was no less remarkable."

GALVESTON SURE IT IS SAFE.

Galveston is assured now of its practical immunity from another disaster like that of 1900. A general feeling of confidence has resulted from the splendid action of the sea wall, which resisted the onslaught of the sea, backed by the hurricane which beat in vain on the concrete wall seventeen feet high surrounding the city on the gulf side of the island several weeks ago.

Karl A. A. Bracher, Toronto, Ont., has discovered a new use for concrete. He substitutes a concrete slab, reinforced with wire mesh,, for the slate that forms the principal feature of a billiard table. A great proportion of the cost of billiard tables is occasioned by the expense in preparing slates that will be absolutely level. The use of concrete should cut down this expense materially.

CANADIAN CEMENT COMPANIES MERGE.

Montreal, July 30.—Announcement is made that plans have been completed for the consolidation in one company of all the cement companies in Canada. The new company will include all the principal cement manufacturing companies in Canada and the consolidated company, which will be known as the Canadian Consolidated Cement Company, will have a capitalization of $25,000,000. An application has been made to Ottawa for a charter for the company.

ACME PORTLAND CEMENT CO.

Spokane, Wash.—The contract for the engineering and construction of the Acme Portland Cement Company's plant at this city has been let to the Fuller Engineering Company, Allentown, Pa. The amount of the contract is said to be between $650,000 and $700,000. Work on the plant will be commenced as soon as possible. The Acme Portland Cement Company has a capital stock of $2,500,000, most of which is held by local people,

The officers of the company are: R. K. Neill, president; John W. Graham, Dr. C. K. Merriam and Aman Moore, vice-presidents; Fred H. Mason, treasurer; E. C. Hadley, secretary and manager; J. W. Hadley, assistant secretary.

The plant will be built in units, the first unit will have a capacity of 1,500 barrels a day. It will be operated by electricity.

CONCRETE LINED WASTEWAY CHANNEL.

Sealed proposals will be received at the office of the United States Reclamation Service, Miller Building, North Yakima, Washington, until July 30, for the construction of Sulphur Creek Wasteway near Sunnyside, Washington. The work consists of the excavation and lining of about one mile of channel and involves the excavation of about 13,300 cubic yards of material and the placing of about 2,100 cubic yards of concrete and 130 cubic yards of paving.

CAPE COD CANAL.

Work has begun on the Cape Cod Canal, the contract having been captured by the Furst-Clark Construction Company of Baltimore, Md. The undertaking involves the removal of 20,000,000 cubic yards of earth at a cost of $3,500,000 and the construction of stone work which will cost $1,500,000 more.

The canal to be dug will be eight miles long, thirty feet deep and with a minimum width at the bottom of one hundred feet. Four miles of channel will have to be dredged to connect the canal with deep water at the two ends. For the completion of the work three years are allowed. The canal will cut through Cape Cod and connect the waters of Massachusetts Bay with Buzzards Bay. It is intended to simplify the all-water route between New York and Boston, shortening the distance and avoiding dangerous navigation. It will be a sea-level canal built after the most approved methods. The completion of the Cape Cod canal will add a link to the inside water route along the Atlantic Coast.

LARGEST CONCRETE PIERS.

The concrete piers of the Clover Bar bridge on the Grand Trunk Pacific railway are said to be the largest all concrete piers in Canada, and perhaps in the world. There are four of them, two of which are 140 feet high and the other seven feet less in height. The bridge from abutment to abutment is 1,660 feet in length. The piers extend 40 feet below the surface of the water. The concrete work was undertaken in midwinter. This was one of the difficulties with which the constructing company had to contend. To work with concrete during cold weather it is necessary to use heat. Houses were constructed around the piers and these were heated with steam, which was conveyed by pipes from a plant on the river bank. After placing and packing the concrete in its molds, it was also necessary that it should be kept heated for at least a day, and then allowed to set gradually.

CEMENT SEWER PIPE PREFERRED.

At a meeting of the Cheltenham-Highlands Association held in Goss Hall May 17, 1909, it was voted to use cement pipe in North Side, Denver, Colo., sewer. There seems to have been a very strong sentiment worked up by the clay pipe interests against concrete pipe. A committee composed of the best business men of North Denver, and consisting of Senator W. W. Booth, C. P. Allen and J. H. Evans, had been previously appointed to report on the efficiency of concrete pipe versus clay. The report of the committee was unanimously in favor of cement pipe. It contained many interesting facts regarding the strength and life of concrete. Rome used concrete pipe in 700 B. C., and also used it in her aqueducts.

Cement pipe was first used in the United States in Brooklyn in 1860, and since that time nearly every city of any size in the United States has adopted its use. The committee reported further that there was a saving of from 25c to 70c per foot over clay pipe on Lake avenue, and further that concrete was absolutely permanent. There are miles of cement pipe in the Denver city ditches today, some of which has been in use for twenty-five years. This was examined and found to be in even better condition today than when it was laid.

CEMENT SHINGLES MAKE GOOD ROOFS.

The writer having been for years engaged in the concrete machinery business, has had ample opportunity to investigate the many devices and formulas for producing cement products, and from such investigations has been able to draw some practical conclusions which may be of interest and profit to the reader if carefully considered, in the light of good logic, and final demonstration which may be required to convince the man who is from the state of "show me."

My purpose in this article is two-fold, that of presenting to the reader our claims for the cement shingle for consideration, and also to inspire a greater degree of confidence in concrete products on the part of all who may chance to read what we have to say on the subject.

Concrete roofing, or cement shingles, is not a new thing by any means, but has taxed the minds and skill of contractors and builders for centuries past and is again being brought forward because of its practicability and lasting quality, and the rapid development of the cement industry has made possible the return to concrete products as structural material for almost every kind and class of structure, as its universal use attests. As a roofing material it has come to stay; on this all agree who have given the matter any thought or investigation, only the manner and method of its use and practical application need to be demonstrated, and to this end there has been, and is now a growing, crying demand for something in the way of a cement shingle and a machine to make it, so that it can be manufactured and sold profitably in competition with the best quality of slate, or the clay products.

There are few people in the concrete business (as in other lines) who are willing to work for the pleasure, and not the profit. This class of business men seem to think that a number one quality of concrete product should be sold in competition with cheap wood construction, and it is but natural for them to insist that cement shingles should be sold in competition with cheap wood shingles, whereas in fact, the cement shingles have no equal for lasting quality if they are made and put on properly. This statement may seem a little broad, but we will proceed to show that it is the truth by citing the reader to the fact that there is in the city of Ha-

vana. Cuba, an old cathedral which is covered with a cement shingle or slab roof that is said to be four hundred years old, and is yet in perfect condition and evidently will outlast the walls of the building even if made of granite. The latter statement relative to the lasting quality of cement products is based on the technical knowledge of a certain professor in one of our great industrial and technical schools, who said recently before a class of students that cement or concrete products, properly made, would outlast stone from any quarry, not excepting granite. From this it would seem that we need not cite other authority, but proceed with our observations about cement shingles, which it will be seen are not an experiment, and to the uninformed we are safe in saying that they have been in use in the Central States for a number of years, during which time they have withstood the intense heat of summer and the severest winters, thereby showing that as a practical roofing material they have no equal.

The reader may have a curiosity now to know something definite about cement shingle, walk and floor tile machine, and its products, but we shall confine our efforts to a description of the shingle. We are frank to say that we have no apology to make for presenting the claims of superiority of the Superior shingle, and will leave it to the good judgment of all as to whether or not our claims are well founded, or the name properly chosen.

First. It is a shingle, not a slab or tile, and in size is about equal to the ordinary roofing slate, but is from fifty to seventy-five pounds lighter to the square than the best black slate.

Second. It is a reinforced cement shingle, and our contention is that a reinforced shingle is superior to one not reinforced; however, if a cheap product is desired, the reinforcement may be left out, which would reduce the cost very materially, as the reinforcement consists of two by twelve inch strips of half-inch mesh wire cloth, which varies in price in different localities, but can be secured through any hardware dealer.

Third. It is nailed on just like a wood shingle, which is made possible by two small pieces of asbestos board which are embedded in the material at the nailing point; the asbestos being pliable, takes care of contraction and expansion, which must be provided for where concrete is exposed to heat and cold. This pliability also admits of any possible settling of the roof which should also be considered and provided for.

Fourth. On the under side of each shingle, a foot is molded which serves a double purpose, that of tilting the shingle so that the asbestos nail pads come in contact with the sheathing above, and at the same time forms an air chamber between the laps which effectually cuts off capillary attraction, which otherwise would obtain if the surface were smooth or level. The foot resting on the under shingle also serves as a protection from storm. The upper edge of exposed ends are beveled so as to overcome the heavy or clumsy appearance, thus adding to the artistic effect of the roof.—J. H. Wiest, St. Louis, Mo.

KOSMOS CEMENT PLANT.

The only plant manufacturing Portland cement in the state of Kentucky is that of the Kosmos Portland Cement Company, located at Kosmosdale. This mill was completed in 1905.

It was found that the product of this mill was a light-colored standard Portland cement, and it quickly found favor in the market of the South. It has been supplying the territory on the Ohio and Mississippi Rivers, as it has splendid shipping facilities.

The mill was partly destroyed by fire September 11, 1908. The fire started in the overhead tramways. The power plant was destroyed in order to save the warehouse which contained several thousand barrels of cement.

Immediately after the fire the work of reconstruction commenced, and after this was completed the mill was again started. It has now been running about 90 days.

The rebuilt plant is on a larger and better scale than before. The capacity has been increased by the additional machinery, and now has an output of 1,500 barrels per day. The machinery is designed that this capacity may be increased to 3,000 barrels when the increased demand warrants it.

The mill is advantageously located and is well equipped to make prompt shipments. The location of the quarry is one of the most ideal of any quarry property in the country. Every natural facility for the production and handling of the rock from the quarry is to be found here.

The equipment of this mill is the best that can be bought and the company has everything in its favor for the economical production of a high-grade and uniform product.

The main office of the company is at the plant. A branch office is maintained at Louisville.

The officers of the company are: Samuel Horner, Jr., president; Charles Horner, vice president; A. McCracken, secretary. C. N. Timmons is the manager of sales.

A brief description of the plant follows:

The plant is located on the Illinois Central Railroad about seventeen miles south of Louisville. The property extends from the Ohio River on the west to the tracks of the Louisville, Henderson & St. Louis Railroad on the east, in all about eight hundred acres. An additional five hundred acres are owned a short distance down the river, where the quarry is located.

The quarry is generally conceded to be the finest of its kind in the country. A cliff 400 feet high with a frontage of half a mile along the river affords the supply of pure oolitic limestone. The quarry level is about 150 feet above the base of the hill, where the power plant and crushers are located. The rock is handled in cars dumping into incline cars operated by a friction hoist, discharging the load automatically into two Gates crushers. Here it is reduced to two and a half inch size, thence on a belt conveyor to the barges, loading by an adjustable swinging spout. The company owns five of the finest deck barges on the Ohio River, each barge having a capacity of 600 to 700 tons of crushed rock.

These barges are towed to the plant and unloaded by a derrick, having a ninety-foot mast and a seventy-five-foot boom, making a complete swing and carrying a yard and a half Jeffrey bucket. This outfit has a capacity of 1,000 yards of material in ten hours. Emptying into a large pocket, the stone is fed into cable cars on a Mead-Morrison tramway system and run either to the mill storage or up an incline trestle to the reserve storage, where 30,000 to 40,000 tons of crushed rock are always kept on hand in case of an emergency. This reserve allows the closing down of the quarry in bad weather. This end of the plant has proven quite economical. The layout of the quarry being such that a minimum number of men are used and on the cable road, two men will take care of the capacity of the derrick and dump into the mill storage. A steam shovel is provided when it is found necessary to call on the reserve storage.

Clay is obtained right at hand. the greater amount ying between the Illinois Central Railroad and the Louisville, Henderson & St. Louis Railroad tracks. there being a supply for generations to come and needing little or no stripping. Plowed and harvested with special clay gatherers, it is dumped through a trap into cable cars similar to the stone-handling system, and emptied automatically into the clay storage. This large building has a capacity for about five months' run. It is possible to harvest only in good weather and obtain sun-dried material. The clay is conveyed from the storage, dried in a 6'x60' Vulcan drier and elevated into a steel bin. It then flows into a steel car and is pulled over the bridge to a tank in the mixer building. The clay, being sun-dried, requires but little further drying, consequently this department supplies sufficient material in ten hours for day and night .

The stone in the mill storage amounting to four days' supply is fed into a scraper conveyor in the tunnel which empties into a special designed Peck overlapping bucket conveyor. This discharges into all or any one of three 7'x60' driers. By a similar Peck conveyor and a belt

New Kosmos Cement Plant.

conveyor the stone is dumped into large steel bins in the mixer building.

A scale car, operated by friction, runs between the stone and clay bins and empties its contents into an incline car which dumps into the ball mill bins. This scale car has proven very efficient, one man readily operating this department. The car has a capacity of two tons; the stone is run in first and balanced on the upper beam; the conterpoise carries a pointer, and it indicates the exact amount of clay required by means of a card clamped on the scale case which has been prepared for the particular stone. Clay is run in to the amount and balanced on the lower beam of the scale. This method allows an exceedingly accurate mix to be obtained at all times.

There are three Allis-Chalmers No. 8 ball mills with all screens removed, ¾" holes in breast plates, and the return opening closed. The product from these mills is elevated and run through an inclined revolving screen to remove any stray balls or nuts. It then passes to the Fuller mill bins. Seven 33" Fuller mills are provided and have given perfect satisfaction. There is storage over the ball mills and Fuller mills for a twelve-hour run.

The material is conveyed to the kiln bins, which have a capacity for eighteen hours' run. The raw mix is burnt in four 7'x80' kilns, discharging into elevators, it is raised and discharged into rotary coolers, one cooler 7'x36' for each kiln. Here it is dumped into cars and then through grates; the clinker finally reaches the clinker storage ¾" and under; the reject from the grates being crushed by rolls. The cars are weighed as they enter the storage and a check kept on the output of each kiln. There is ample room in the clinker storage for about eight or nine days' run, thus insuring cool, well-seasoned clinker for the finishing mills. By screw conveyors and elevators it is emptied into Grffin mill bins. Before leaving the clinker storage it is weighed in a revolving weighing machine which operates a "baby" machine giving the right amount of plaster of paris.

Twelve Griffin mills make up the finishing equipment. The stock house has a capacity of 50,000 barrels and is of reinforced concrete and divided into three large bins.

The coal mill contains a Williams hammer mill, drier and three 33" Fuller-Lehigh mills. The drier is heated by an outside furnace. The gases circulating around the drier are then conveyed to the discharge end and pass through the drier to stack.

The raw, finishing and coal mills are driven by Corliss engines 18x36x42, 16x24x42 and 12x24x30, respectively. The raw and finishing mills are directly connected to a line shaft running through each mill, with a counter shaft of the same size run by rope drive; half of the mills drive from each shaft. The coal mill engine drives the line shaft by means of a long system rope drive.

The kilns, driers, outside cable roads and all other machinery is electrically driven. The current is furnished by two 200 K. W. steam turbines connected to Allis-Chalmers generators, 3 phase, 60 cycle, 7,200 alternations, 440 volts. The power is distributed from a very handsome panel board; the generator panels carrying oil immersed switches and the feeder panels, oil immersed circuit breakers with time relays; Tirrel regulator and synscroscope are also provided. The board is most complete in every detail. A 20 K. W. turbine connects to a small generator furnishing D. C. current for excitation and when under way this machine is cut out and a motor-generator set used to excite. There are nine main power leads taken from the board and distributions made in each building from metal junction boxes.

Circulating pumps, fire pumps, enclosed heater and all steam and exhaust piping are carried in the basement of the power house, leaving the engine room free from all obstructions. Three barometric condensers have given perfect satisfaction, an average vacuum of over 27" being held for all seasons of the year. An abundance of cool water is available as a lake averaging 10" to 15" deep and one-quarter mile long, lays between the plant and the river and, being a natural water shed, the

water is particularly soft for boiler feed purpose. The pump house at the lake has two single stage centrifugal pumps; one vertical 2,500 g.p.m. direct connected to 100 h. p. Allis-Chalmers motor and one horizontal 1,800 g.p. m. direct connected to Type "C"; three pumps are also provided in case of an emergency.

Power is supplied by five vertical water tube boilers, 250-h.p. each, four of which are so arranged as to utilize the waste heat from the kilns. The gases from the kilns pass through a settling chamber and are then admitted to the boilers about half way up in front of baffle wall just over the furnace gases, they then pass through an economizer, which was installed by the Green Fuel Economizer Co., Mattewan, N. Y. The draft is regulated by an induced draft fan. Auxiliary stacks, 90′ high and 5′ 6″ in diameter are also provided, one for each two kilns. Reinforced concrete dampers are so arranged that gases either pass through the boiler or to the outside stack as found desirable. This arrangement has been found satisfactory and quite economical as attested by the total fuel cost per barrel. The steam for the turbines is heated to 150° superheat through a superheater.

All the leather belting in the entire plant is of the best, and was furnished by the Chicago Belting Co.

The plant partially destroyed by fire last fall has been rebuilt and at present is a model of fireproof construction, concrete, steel and corrugated iron being used. Timber is conspicuous by its absence. The plant originally designed for 1,000 barrels has been brought up to 1,500 barrels and provision was made during the reconstruction to increase to 3,000 barrels this coming spring.

Shipments are for the most part made over the I. C. R. R. but in anticipation of the increased capacity a switch has been surveyed to the L. H. & St. L. road. The river transportation has been rather light up to the present, but plans are under way to utilize this most favorable asset by distribution to the various large cities along the Ohio and lower Mississippi by covered barge.

There is an abundance of raw material, and water and coal is available by both railroad or river. Pittsburg coal is obtained by barge and unloaded in the same manner as the stone, a branch cable road placing it at the coal trestle. West Kentucky coal is used, however, the greater part of the time and has proven quite efficient, a large trestle from the I. C. R. R. bringing it close to coal mill and boiler room.

Boiler-House and Coal Trestle—Standard Portland Cement Co.

The raw materials are remarkably pure, the limesto running about 98 per cent carbonate of lime and less th 0.75 per cent magnesia. The clay is very uniform a

Limestone Quarry—Standard Portland Cement Co.

rather a high silica clay, the silica, however, being in com bination and only showing a small percentage free. Bein low in Ae_2O_3 and F_2O_3 Kosmos cement has given th very best of satisfaction, the set is remarkably uniform and the resulting cement is particularly light in color.

A point worth mentioning is the beautiful accommoda tion afforded the employees. The village located betwee the plant and the river is made of concrete houses o tasty design, with ample room for lawns for each home The village is lighted by electricity and houses are pro vided with all modern conveniences. The whole villag shows the thrift and care of the employees of an organi zation which has been the subject of much favorable com ment.

CEMENT PLANT AT LEEDS, ALA., ENLARGED

The plans for the enlargement of the plant of the Standard Portland Cement Co. at Leeds, Ala., are now about completed. The new equipment, which will give the plant a capacity of 1,500 barrels of Portland cemen a day, will be of the most modern character for eco nomical production. An Allis-Chalmers condensing turbine generator will be used, developing three-phase alternating current at 440 volts, and the entire plan will be driven by electricity. The motors were fur nished by Allis-Chalmers Co. These machines are being put up with large capacity for the work they are re quired to do, and with especially heavy transmissio wires, so that current will be delivered to the motor with small loss in voltage.

A large canal system for the storage and cooling o water for the condenser is being constructed to Moor Creek, which runs around the plant at an average dis tance of 600 feet. The boilers supplying the generating system develop superheated steam at 150 pounds pressure. A complete coal-conveying system is being installed in connection with the boilers.

To cover the objection of the insurance inspectors the

oal-drying and coal-grinding buildings have been placed utside the plant at a distance of 90 feet from the earest buildings, and have been separated by about 60 eet. This will insure the lowest insurance schedule n the plant, although as a matter of fact the plant is f steel construction throughout and the fire hazard is ractically nothing.

For economy in handling stone to and through the ant a system of steel tanks holding from 300 to 400 ns each are being built. The type and method of conructing these tanks are shown in an accompanying lustration. These will receive the stone at the top y means of elevating and conveying machinery and ischarge through the hopper bottoms onto belt conyors at the bottom. The entire cost of handling 400 500 tons of stone a day will be almost nominal.

The kilns for burning the raw materials are seven eet in diameter and 100 feet long. The greater part f the grinding mills installed are the Fuller-Lehigh attern, made by the Lehigh Car Wheel and Axle Vorks, Catasauqua, Pa.

In conjunction with the enlargement and the inreased capacity of the plant a switch connection is being uilt to the Central of Georgia Railroad. This will ive direct rail connection with a large territory in outhern Alabama and Georgia. Up to the present time ie company's only rail outlet has been with the Southrn Railway, because of the difficulty of constructing ie connection with the Central of Georgia. This latter ailroad passes alongside the company's plant, but at a igh level on the side of the hills, thus making the onstruction very expensive. This, however, has now ecome so important that it is being made without regard first cost.

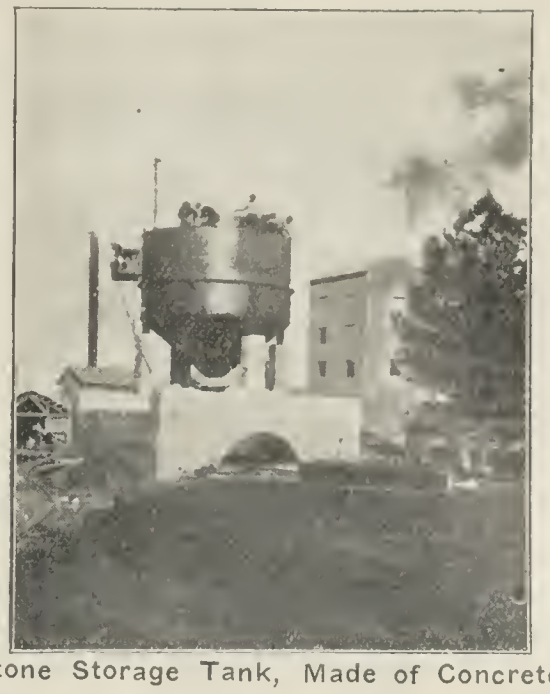
Several features of the enlarged plant are shown the accompanying illustrations, among them being the oiler-house and coal trestle, the limestone quarry and ie concrete coal hopper for storing coal.

Leather belting was furnished by Chicago Belting ompany, as they make the best for cement mills.

The Standard Portland Cement Co. was organized 1 1906 by a small body of stockholders in Virginia nd Charleston, S. C. The initial capacity of the plant rected here was 400 barrels daily, which was quite small unit compared with the other cement plants f the country. This little plant, however, has run eadily since its completion, and was in continuous peration during 1908.

The location of the plant is unusually favorable.

Concrete Coal Hopper.



Stone Storage Tank, Made of Concrete.

Trenton limestone occurs at Leeds in measures of unusual purity and of great thickness, and produces a cement of high quality and light silver-gray color. A section of the limestone deposit shows a total thickness of not less than 800 feet, with color and texture uniform. In the valley, one and one-half miles west of Leeds, the Cahaba gas-coal measures extend north and south for 100 miles. This coal is mined within two miles of the cement plant, and is delivered to it at a transportation rate of 25 cents a ton.

The capital of the company upon completion of the enlargement will be $500,000, representing the actual cost of the property and plant, plus working capital required. The officers of the company are J. Ross Hanahan, president and treasurer, Charleston, S. C.; R. Jackson Scott, secretary, Charleston, S. C.; F. H. Lewis, general manager, Leeds, Ala., and P. C. Lindon, assistant treasurer Leeds, Ala.

In line with its expansion the company will on April 1 open a sales office in the Brown-Marx Building, Birmingham, Ala., in charge of J. Innis McCants as general sales agent.

The contract for building 1,000 feet of reinforced concrete docks for the Deering works of the International Harvester Company, Chicago, has been let. W. D. Price, engineer. The docks will be located along the north branch of the Chicago River.

THE CEMENT INDUSTRY IN THE UNITED STATES IN 1908.

By Edwin C. Eckel.

PRODUCTION.

Before taking up the statistics relating to the three kinds of cement separately, it is of interest to summarize the facts relative to the total cement production of the United States in 1908.

The total quantity of Portland, natural, and puzzolan cements produced in the United States during 1908 was 52,910,925 barrels, valued at $44,477,653. As compared with 1907, whose production was 52,230,342 barrels, valued at $55,903,851, the year 1908 showed an increase of 1.3 per cent in quantity, and a decrease of 20 per cent in value. The increase in quantity is the smallest ever recorded, and the heavy decrease in value indicates the serious trade conditions which the cement industry encountered during 1908.

The distribution of the total production among the three main classes of cement is shown in the following

table. For comparison the figures for 1906 in 1907 are also presented.

TOTAL CEMENT PRODUCTION, 1818-1908.

It is of advantage to summarize, at intervals, the complete statistics relative to any industry. For this reason the present report contains tables giving the production, in each year, of Portland, natural, and puzzolan cements since the commencement of their manufacture in the United States. In the following summary table these figures are combined so as to give the total production of all kinds of cement in the United States to date:

Production of Portland cement in the United States, 1870–1908, in barrels.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1870–1879	82,000	$246,000	1894	798,757	$1,383,473
1880	42,000	126,000	1895	990,324	1,586,830
1881	60,000	150,000	1896	1,543,023	2,424,011
1882	85,000	191,250	1897	2,677,775	4,315,891
1883	90,000	193,500	1898	3,692,284	5,970,773
1884	100,000	210,000	1899	5,652,266	8,074,371
1885	150,000	292,500	1900	8,482,020	9,280,525
1886	150,000	292,500	1901	12,711,225	12,532,360
1887	250,000	487,500	1902	17,230,644	20,864,078
1888	250,000	487,500	1903	22,342,973	27,713,319
1889	300,000	500,000	1904	26,505,881	23,355,119
1890[a]	335,500	704,050	1905	35,246,812	33,245,867
1891	454,813	967,429	1906	46,463,424	52,466,186
1892	547,440	1,153,600	1907	48,785,390	53,992,551
1893	590,652	1,158,138	1908	51,072,912	43,547,679
				395,567,395	

[a] The figures for 1890 and prior years were estimates made at the close of each year, but are believed to be substantially correct. Since 1890 the official figures are based on complete returns from all producers.

PORTLAND CEMENT.—PRODUCTION.

The total Portland cement production of the United States in 1908 was 51,072,612 barrels, valued at $43,547,679. As compared with the output of 1907, which was 48,785,390 barrels, valued at $53,992,551, the figures reported for 1908 indicate an increase in quantity of 4.6 per cent and a decrease in value of 19.3 per cent.

In view of the trade conditions during the year, the matter for surprise is not that the increase in output was so small, but that there should have been any increase at all. When the total production is grouped by States, as in the table below; certain peculiarities of distribution of this increase become obvious; and when the reports of individual plants are examined, the matter becomes still more interesting. In the present place it can only be said that all of the older producing States, especially in the East, showed heavy decreases in output; that a relatively small number of plants, mostly in the Middle West, reported very large increases as against 1907; and that the only really large producer to report an increase was the United States Steel Corporation. This latter fact is the more interesting because, as shown in the table immediately following, the gain reported by the Steel Corporation accounts for all (and more than all) of the increase in production for the country.

It need hardly be explained that the figures here quoted, as giving the output of the Steel Corporation's cement plants, are taken from the annual reports of the Corporation as issued, so that there is no violation of confidence in presenting them thus separately.

PRODUCTION BY STATES.

In the following table the Portland cement production has been grouped by States. For convenience in comparison, the production for 1907 is also presented in as nearly similar grouping as is possible.

RANK OF PRODUCING STATE.

In 1906 and 1907 the leading cement-producing States ranked in the same order, as follows: Pennsylvania, New Jersey, Indiana, Michigan, Kansas, New York, Illinois, Missouri. In 1908, however, some very curious changes in rank occurred, owing to the decreases shown by the Eastern States and Michigan, and the heavy increases reported from some of the Middle Western States. The order of production in 1908 was therefore as follows: Pennsylvania, Indiana, Kansas, Illinois, New Jersey, Michigan, Missouri, New York.

Production of Portland cement in the United States in 1907 and 1908, by States.

1907.				1908.			
State.	Producing plants.	Quantity (barrels).	Value.	State.	Producing plants.	Quantity (barrels).	Va
Pennsylvania	22	20,393,965	$17,698,005	Pennsylvania	17	18,254,806	$13,8
New Jersey	3	4,449,896	4,738,516	Indiana	7	6,478,165	5,3
Indiana	7	3,782,841	4,757,860	Kansas	7	3,854,603	2,8
Michigan	14	3,572,668	4,384,731	Illinois	5	3,211,168	2,7
Kansas	5	3,353,925	4,240,358	New Jersey	3	3,208,446	2,4
Kentucky	1	3,186,925	3,320,248	Michigan	15	2,892,576	2,5
Missouri	2			Missouri	4	2,929,504	2,5
New York	9	2,290,955	2,433,918	California	4	2,480,100	3,2
Illinois	5	2,036,093	2,632,576	Washington	2		
California	4	1,893,004	2,715,398	New York	7	1,988,874	1,8
Washington	1			Ohio	8	1,521,764	1,3
Alabama	2	1,274,470	1,383,305	Iowa	1	1,205,251	1,1
Georgia	1			Kentucky	1		
Virginia	1			Tennessee	1		
West Virginia	1			Texas	2	917,977	
Ohio	9	1,151,176	1,377,155	Oklahoma	2		
Colorado	1	864,938	1,395,179	South Dakota	1	809,306	1,0
Utah	2			Colorado	2		
Arizona	1	534,534	915,301	Arizona	1	507,603	
South Dakota	1			Utah	2		
Texas	2			Maryland	1	502,225	
				Virginia	1		
				Massachusetts	1		
				Alabama	2	310,244	
				Georgia	1		
	94	48,785,390	53,992,551		98	51,072,612	43,5

PRODUCTION BY DISTRICTS.

The present geographic distribution of the Portland cement industry is indicated in the following table where the total production of the years 1905, 1906, 1907, and 1908 is grouped according to locality.

The term "East," as used in these tables, includes plants in Pennsylvania, New Jersey, New York, and Massachusetts. The "Central" plants are those in Ohio, Indiana, Michigan, Illinois, Iowa, and Missouri. Under "West" are included plants in Kansas, Colorado, South Dakota, and Texas. The "Pacific coast" plants are located in Maryland, Virginia, West Virginia, Kentucky, Tennessee, Georgia, Alabama, Oklahoma, and Texas.

Geographic distribution of the Portland cement industry, 1905–1908.

District.	Output, in barrels.			
	1905.	1906.	1907.	1908
East	19,589,675	25,483,025	27,134,816	23,472
Central	10,723,802	14,030,665	13,479,703	17,744
West	2,470,349	3,834,656	4,463,397	5,171
Pacific coast	1,225,429	1,310,435	1,893,004	2,480
South	1,237,557	1,804,643	1,814,470	2,204
	35,246,812	46,463,424	48,785,390	51,072

District.	Plants in operation.				Percentage of total output			
	1905.	1906.	1907.	1908.	1905.	1906.	1907.	19
East	30	31	34	28	55.6	54.9	55.6	
Central	32	34	37	40	30.4	30.2	27.6	
West	7	8	10	13	7.0	8.2	9.2	
Pacific coast	3	4	5	6	3.5	2.8	3.9	
South	7	7	8	11	3.5	3.9	3.7	
	79	84	94	98	100.0	100.0	100.0	

PRODUCTION OF THE LEHIGH DISTRICT, 1890-1908.

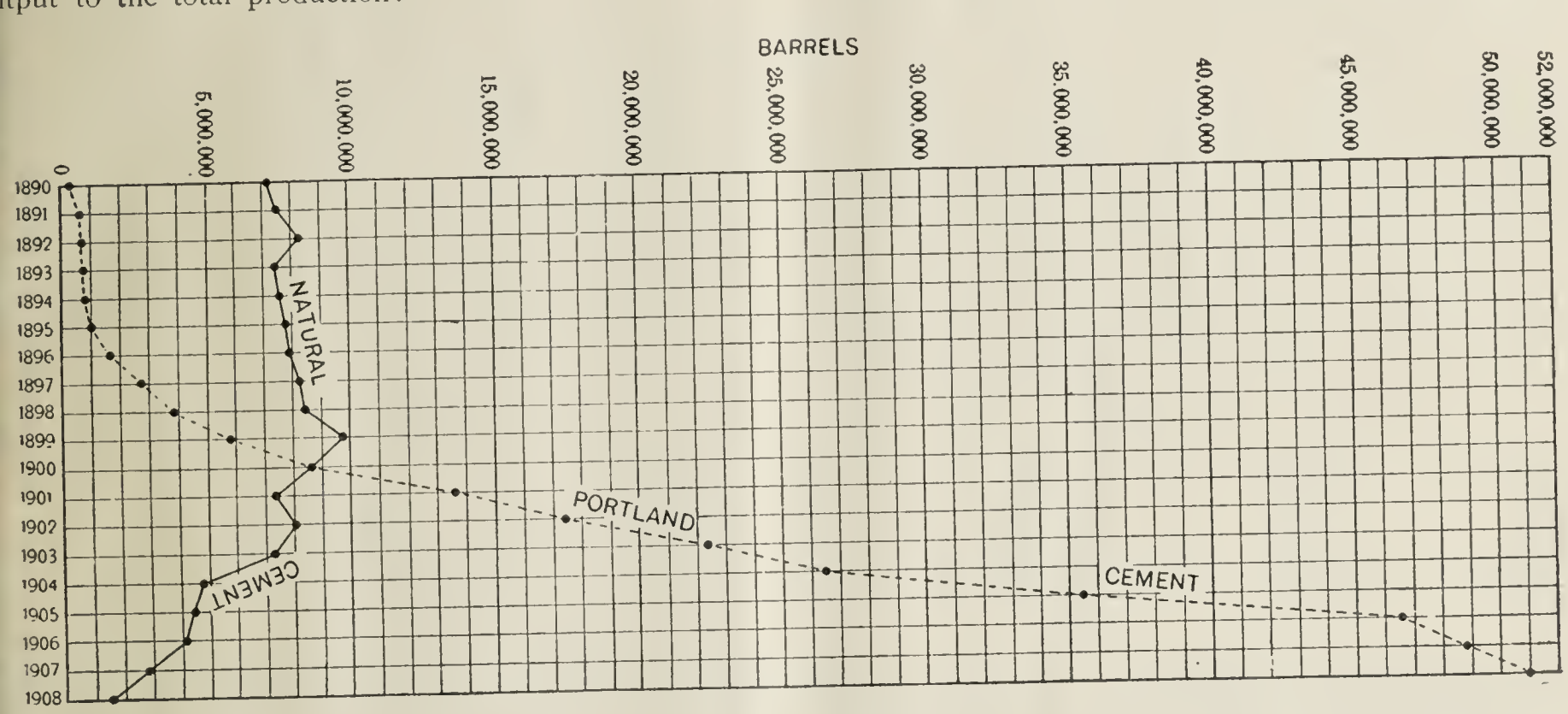
In an earlier report of this series the statement was made that "The Portland cement industry exhibits the same tendency toward geographic centralization, though to a less degree, that has given Pittsburg its pre-eminence as an iron producer. In the case of the Portland cement industry the concentration of plants is in the so-called Lehigh district of Pennsylvania with its New Jersey continuation. The Lehigh district was the point where Portland cement manufacture was first undertaken, and it owes its continued pre-eminence to the possession of good raw materials, good labor, good and fairly cheap fuel, and excellent transportation facilities to large eastern markets."

At the present time it might well be added that just as the future of the Pittsburg steel district is defi

ely limited by the growth of production at Gary, Buffalo, Birmingham, and the Atlantic plants, so the Lehigh district is now facing similar limitations. Each year witnesses a marked narrowing of the profitable market area for cement made in the Lehigh district. The existing plants in western Pennsylvania now control the situation, during ordinary years, in that direction, while existing and prospective plants in West Virginia, Virginia, and New York will more and more restrict shipments to the South and East.

The Lehigh district possesses great manufacturing advantages, and its annual output has by no means necesarily reached its maximum, but the decrease in the margin of profit and the narrowing of the market area are so obvious that strong companies can no longer look to their Lehigh district plants as being sufficient for the future.

The following table shows, by three-year periods since 1890, the production of the Lehigh district, the total production, and the percentage of the Lehigh district output to the total production:



Portland cement production in the Lehigh district and in the United States, 1890–1908, in barrels.

Year.	Lehigh district output.	Total output.	Percentage of total manufactured in Lehigh district.	Year.	Lehigh district output.	Total output.	Percentage of total manufactured in Lehigh district.
1890	201,000	335,500	60.0	1899	4,110,132	5,652,266	72.7
1891	248,500	454,813	54.7	1900	6,153,629	8,482,020	72.6
1892	280,840	547,440	51.3	1901	8,595,340	12,711,225	67.7
1893	265,317	590,652	44.9	1902	10,829,922	17,230,644	62.8
1894	485,329	798,757	60.8	1903	12,324,922	22,342,973	55.2
1895	634,276	990,324	64.0	1904	14,211,039	26,505,881	53.7
1896	1,048,154	1,543,023	68.1	1905	17,368,687	35,246,812	49.3
1897	2,002,059	2,677,775	74.8	1906	22,784,613	46,463,424	49.0
1898	2,674,304	3,692,284	72.4	1907	24,417,686	48,785,390	50.0
				1908	20,200,387	51,072,612	39.6

THE STATUS OF NEW YORK AS A CEMENT PRODUCER.

In view of the relation of New York to the early history of the Portland cement industry in this country, it is a matter of surprise that the State has not assumed a more prominent position in the present stage of the industry. The matter can not be cleared up referring its low rank to deficiencies in raw materials, transportation routes, or markets, for a very casual examination will show that its supplies of available raw materials are large, and that it contains or gives ready access to a number of important markets. The facts that during 1908 it ranked eighth among the States as a cement producer is therefore to be explained otherwise.

New York State at present contains a number of Portland cement plants, but even the successful ones have been able to exert little influence on the industry at large. This is chiefly due to the manner in which they were located, when regard was paid chiefly to the limestone supply and only secondarily to questions of market. To build a cement plant so located as to yield only cement may be an interesting technical operation, but it is not good business. In order to be satisfactory industrially, a plant should produce dividends as well as cement. In the past history of the New York industry this fact seems to have been overlooked.

When the situation is examined critically, with markets, routes, and raw materials all in mind, it will be seen that there are only a few locations in New York where to-day the erection of a large plant would be justifiable. In the writer's opinion the number of such areas or localities does not exceed four. To put the matter in another way the erection of large plants at each of these localities would dominate the cement trade not only of New York but of New England as well. To add to the interest of the situation, it may be noted that in three out of the four critical areas the raw-material supplies were geographically so compact that it was by no means impossible for one company to secure complete control of all the really available rock.

In order to compare the ideal with the actual New York locations, it can be said that a year ago three of the controlling areas were not held by any cement company which for many reasons could not avail itself of its natural advantages of location. The last twelve months, however, have brought about many changes in the cement trade, and readjustments in New York are not among the least of them. Of the four locations noted, that at Hudson is now controlled by leading interests in the Atlas Portland Cement Company; two of the other areas are held by another established company, and the fourth may be developed in the near future. The result of these acquisitions is that New York State will have a new series of modern and well-located plants, and that its output may then approximate that of Indiana.

GROWTH OF PORTLAND CEMENT INDUSTRY, 1870-1908.

In the table following statistics are given covering the annual production of Portland cement in this country from the inception of the industry, in the early seventies, to the present day:

On examination of this table it will be seen that the industry showed a fair but not in any way remarkable rate of growth from its commencement in the seventies

until 1895. At the latter date, however, a very striking development commenced co-incident, it may be noted with the development of coal burning in the rotary kiln. This rapid rate of growth continued until 1907, when it was checked temporarily by the financial crisis of that year.

The phenomenal growth of the industry in this period is illustrated very strikingly in figure 1, where it is shown graphically for the years 1890 to 1908, inclusive. For comparison, the decline in the natural cement industry is plotted on the same diagram.

On examining the cement statistics for a series of years, it will be seen that the output of Portland cement has so far shown an increase each year, rising from 42,000 barrels in 1880 to 335,500 barrels in 1890, to 8,482,020 barrels in 1900, and to 51,072,912 barrels in 1908. Tht natural cement production, on the other hand, reached its maximum in 1899, with an output of 9,868,179 barrels. Since that year it has shown an almost continuous and rapid decrease annually, until now it has become a relatively unimportant factor in the cement situation.

DECLINE IN CEMENT PRICES, 1880-1908.

Perhaps the most striking feature connected with the Portland cement industry in this country has been the decline in cement prices during the last thirteen years. This decline has, as a matter of fact, been as steady and as marked as the growth in annual output.

The following table gives the average price per barrel of Portland cement in bulk at the point of manufacture derived from the official figures published annually by the Geological Survey. The price excludes the cost of the package but includes packing-house labor.

Average prices per barrel of Portland cement, 1870–1908.

1870–1880	$3.00	1892	$2.11	1901	$0.99
1881	2.50	1893	1.91	1902	1.21
1882	2.01	1894	1.73	1903	1.24
1883	2.15	1895	1.60	1904	.88
1884	2.10	1896	1.57	1905	.96
1885–1888	1.95	1897	1.61	1906	1.13
1889	1.67	1898	1.62	1907	1.11
1890	2.09	1899	1.43	1908	.85
1891	2.13	1900	1.09		

In the following diagram (fig. 2), the fall in cement prices during the period 1880–1907 is shown graphically:

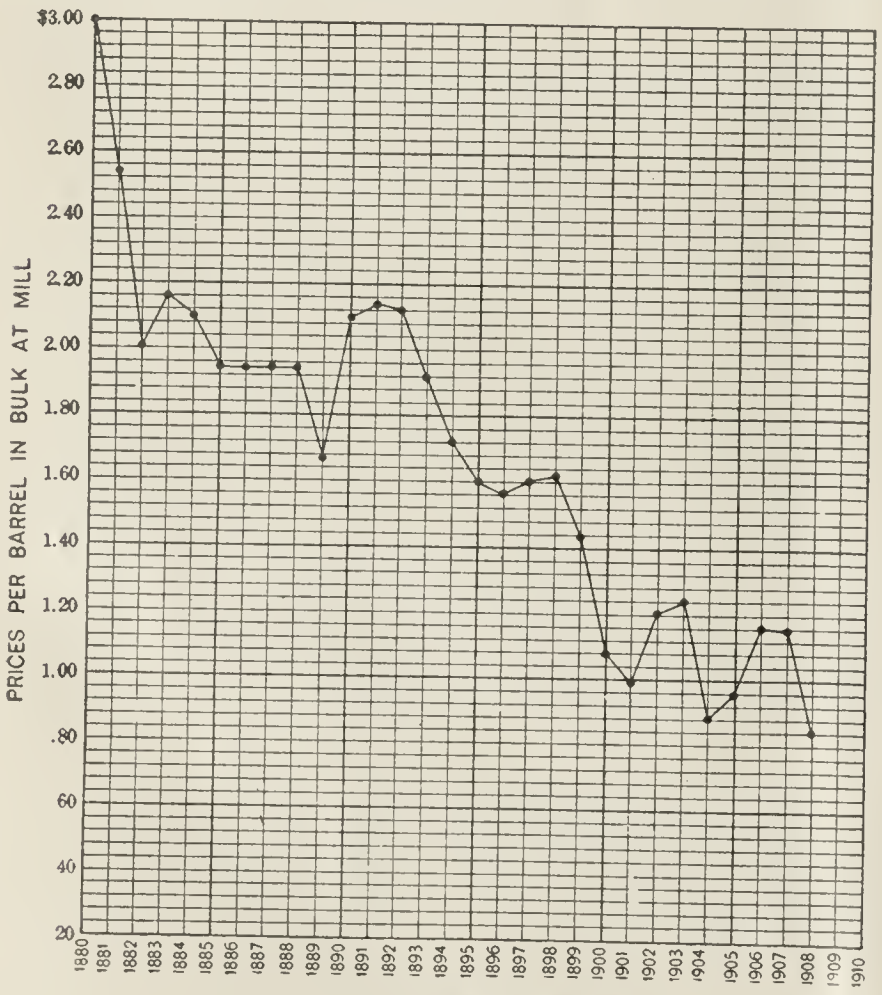


FIGURE 2 – The decline in cement prices, 1880–1908

PRODUCTION ACCORDING TO RAW MATERIALS USED.

In the following table the production of Portland cement in the United States is classified according to the kinds of raw material from which the cement is manufactured. The production is grouped as follows :

Type 1 includes cement produced from a mixture of argillaceous limestone ("cement rock") and pure limestone. This is the combination of materials used in all the cement plants of the Lehigh district of Pennsylvania and New Jersey, and also at several western plants.

Type 2 includes cement made from a mixture of comparatively pure limestone with clay or shale. This mixture is employed at many plants all over the United States.

Type 3 includes cement manufactured from a mixture of marl and clay. This type of mixture is used only in the States of Michigan, Ohio, Indiana, and New York.

Type 4 includes Portland cement manufactured from a mixture of limestone and blast-furnace slag.

This table, brought up to date, shows a continuation of movements whose trend has been noted in earlier years—the decrease in the relative production from cement rock (type 1) and from marl (type 3), and the corresponding increase in the production from limestone (type 2) and from slag (type 4). The falling off in relative output from marl is natural enough, and this relative decrease may be expected to continue. The decrease in the percentage produced from cement rock is due simply to the lessening comparative importance of the Lehigh district, a condition concerning which there is some discussion on a preceding page and concerning which it may be added here that this trend may be reversed in the near future. Two districts, containing cement rock of the Lehigh type but widely separated geographically from the Lehigh district itself, may reasonably be expected to become heavy producers within the next two or three years.

All of the Portland cement now made in this country from slag and limestone is the output of the Universal Portland Cement Company, a subsidiary of the United States Steel Corporation. The product is a true Portland cement in every sense of the term, and the growth of output reflects credit on the way in which prejudice and ignorance have been gradually overcome.

Production, in barrels, and percentage of total output of Portland cement in the United States according to type of material used, 1898–1908.

Year.	Type 1. Cement rock and pure limestone.		Type 2. Limestone and clay or shale.		Type 3. Marl and clay.		Type 4. Slag and limestone.	
	Quantity.	Per-centage.	Quantity.	Per-centage.	Quantity.	Per-centage.	Quantity.	Per-centage.
1898	2,764,694	74.9	365,408	9.9	562,092	15.2	.....	.....
1899	4,010,132	70.9	546,200	9.7	1,095,934	19.4	.....	.....
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,209	16.1	2,001,200	15.7	164,316	1.3
1902	10,953,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	55.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1905	18,454,902	52.4	11,172,389	31.7	3,884,178	11.0	1,735,343	4.9
1906	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,693	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9

NATURAL CEMENT—PRODUCTION.

The natural cement produced in the United States during 1908 amounted to 1,686,862 barrels, valued at $834,509, as compared with an output of 2,887,700 barrels, valued at $1,467,302, in 1907, a decrease in 1908 of 1,200,838 barrels, or over 41 per cent, in quantity, and of $632,793, or over 43 per cent, in value.

PUZZOLAN CEMENT.—PRODUCTION.

Puzzolan cement, made by mixing blast-furnace slag with slaked lime, was manufactured during 1908 at a number of plants in the United States. The output reported for 1908 was 151,451 barrels, valued at $95,468. This shows a heavy decrease when compared with the

oduction reported for 1907, which was 557,252 bar-s, valued at $443,998.

There are at present at least ten plants equipped for manufacture of puzzolan cement in the United ates, though it is difficult to ascertain how many of se have been completely or partly dismantled. Of ten plants constructed, the States of Ohio and Ala-ma contained two each, while Illinois, Kentucky, aryland, New York, Pennsylvania, and New Jersey d single plants. During 1908 four plants reported oduction to the Survey.

IMPORTS OF FOREIGN CEMENT.

The following table shows the foreign cement in-ted into the United States during the years 1878 to 08, inclusive. It is to be noted that, owing to the nner in which statistics are grouped under existing iff schedules, the quantities given include not only rtland cement, but all other hydraulic cements. The rtland cement, however, probably makes up at least per cents of the total in each year.

EXPORTS.

The United States now possess only a small export de in cement, the quantity annually exported ranging ually between 1 per cent and 3 per cent of the do-stic production. There seem to be excellent reasons increasing this export trade as rapidly as possible. l it may soon become a more important feature of industry.

The following table gives the quantity and value of classes of hydraulic cement exported during the rs 1900-1908, inclusive. These totals represent al-st entirely exports of Portland cement.

Exports of hydraulic cement, 1900–1908, in barrels.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
00	100,400	$225,306	1905	897,686	$1,387,906
01	373,934	679,296	1906	583,299	944,886
02	340,821	526,471	1907	900,550	1,450,841
03	285,403	433,084	1908	846,528	1,249,229
04	774,940	1,104,088			

means of distribution to a wide field. In the little city of Rockmart the presence of the Southern States Portland Cement Co. is evidenced on every side by substantial concrete houses, which have been erected with this company's material and very often through the influence of its enterprising management.

The plant and its accessories, in themselves, form quite a village which, while not the size of Rockmart, is very complete and contains everything essential for the comfort and convenience of the company's employes. There is a village store, a hotel and scores of cottages for the accommodation of the employes, superintendents and others in charge of the company's operations. The executive staff, while having accommodations at the plant, also, as a rule, have residences in Rockmart. The store is not operated for profit, but for the convenience of the operatives and the company has a system of checks or metal discs which employes are allowed to draw between paydays, and which are accepted at the commissary at their cash value.

The first of the company's buildings, which greets the eye of the visitor, is the large and substantial power plant. This is a substantial brick building equipped with a full complement of boilers, engines, dynamoes, and other power appliances. The cleanliness of this power plant is remarked upon by everyone who sees it, as it is given almost as careful attention as a watch, and the bearings, oil cups, etc., shine from an entire absence of dirt, gum and other foreign substances.

The quarries of the company lie on the extreme right from the power house, and here the lime stone and shale are mined and conveyed to the plant on regular mining cars, which are operated by means of locomotives adapted to local conditions. Only a small amount of power is required to propel the cars to the plant from the quarry, as gravity does a large part of the work and the principal work of the engines is to push the cars back to the quarries after unloading.

Next in order of the buildings is the chemical laboratory, in which exhaustive experiments are conducted

Bird's Eye View of Southern States Portland Cement Company's Plant, Rockmart, Ga.

SOUTHERN STATES PORTLAND CEMENT PLANT.

The Southern States Portland Cement Co. located at ckmart, Ga., is one of the South's most solid and en-prising manufacturers of Portland cement.

This company was one of the first that was estab-ed in the South, and from the start on account of high grade of its product it took a grip upon the de, which it has since held without intermission.

The plant is located about two miles from the center Rockmart and is on the Southern and Seabord Air ne Railways, thus giving its product an immediate daily. This work is in charge of experts and every run of raw material must come up to an established standard before the process of manufacture is completed.

The dry process of making cement is in use at this plant. Its equipment is divided in units of ten, so that the out-turn can be regulated with precision, when conditions do not justify the operation of the plant on full time. The equipment is complete in every respect, and a full line of machinery necessary to secure the best results is in use. This is, of course, largely automatic in its operation with the view of eliminating human

labor as far as possible under the kilns and in other places where a man is subjected to trying conditions. Although the plant was constructed and is operated with this idea in mind, the demand for human intelligence can not be supplied by machinery, and a large colony of laborers is required to keep the plant going.

From the mills the cement is conveyed to the warehouse, which has a capacity of 150,000 barrels, separated into bins from which the finished product is sent to automatic sackers and placed in Bates valve bags. The packing department is operated by a large number of workmen who look after all the details of repairing, shipping, etc.

The machine shop of the company is the next building in order, and here an equipment of all kinds of machine tools is maintained, and in the stock room every part of all the cement manufacturing machinery is kept in stock, thus enabling the company in any ordinary case to avoid serious delays in the operation of the plant by the substitution of a new part in any machine that is damaged in the course of operation, while the part which has been damaged is undergoing repairs.

The machine shop is the last building in the manufacturing group, with the exception of the superintendent's office. Leaving these, on the left are the neat rows of employes' cottages, and on the right the store or commissary department. The extrement building is the hotel, which lies as far distant from the cement plant as could be conveniently arranged in order to free it from dust and noise, which are usually prevalent around plants of this character. In this building are located the offices of the company and the quarters of a number of its clerical employes and others having office duties. The hotel not only accommodates its regular guests, but each day spreads a lunch for the officers and the official family of the company.

While tapped by two railroads, the company owns all of the tracks that lie on its lands, amounting to several miles of rails. In this and in all other respects this industry was founded with the view of completeness in itself and its policy has been carried out with such uniformity that it is nearly independent of the outside world as any segregated institution could become.

Throughout the dullness which prevailed in the cement trade during the past year or more, the operations of the Southern States plant have been steady, and it was never necessary to shut down the plant for more than a brief period during the time when a great many mills were idle. This fact was very gratifying and enabled the company to not only preserve its organization, but to also make a most favorable financial showing during the period of depression.

Main Works and Laboratory of Southern States Portland Cement Co., Rockmart, Ga.

THE EMERICK IMPROVED AIR SEPARATOR AND EMERICK PULVERIZER.

Geo. S. Emerick, Nazareth, Pa., has recently issued a new pamphlet which illustrates and describes the Emerick Improved Air Separator and Pulverizer. The separators are widely known in the industry and their usefulness to secure any desired uniform fineness has been proven by a number of tests from plants in which these machines have been installed. The Emerick Ball Pulverizer, however, does not enjoy the wide publicity This mill has a number of advantages, one of which is that the machine has no screens.

Power Plant of Southern States Portland Cement Co., Rockmart, Ga.

The feed passes from the hopper to the feed channels in the spider driving the balls, from here the raw material is fed to the grinding ring by centrifugal force feeding in the path the balls must travel. Five 9¼ inch diameter steel balls run on a grinding ring of locomotive tire steel, each ball laying in a separate compartment from which they can be easily removed. There are no bolts, pins, etc., on the interior of the machine. The illustrations in the catalogue fully show the details of every part of the mill, which makes the impression of having the features of a simple, strong and durable pulverizer.

AUTOMATIC WEIGHING MACHINES.

Rapid and automatic weighing of materials is an important function in large cement works and the duty is now entrusted to machines which must be accurate. The cement machines used for mixing the limestone and other materials are set up tandem fashion. The crude materials are first crushed to pieces and fed into hoppers leading to the respective weighing machines. In one of the receptacles of the tandem machine must be deposited, say 200 pounds of limestone, and in the other receptacle eighty pounds of clay or shale stone.

These materials fall from the hopper on a metal slatted conveyer, the speed of which is automatically controlled by the weighing receptacle. To illustrate: Limestone being used in quantity two and one-half greater than the shale, the speed of the conveyer to that receptacle is two and one-half times that of the shale conveyer. When 190 pounds of the limestone has been deposited in the limestone receptacle and eighty-five pounds of shale in its respective receptacle, a trip lever reduces the speed of both conveyers proportionately, and the final quantities making up the total weights drop into the receptacles slowly until the exact weight is obtained. By another lever device, which operates only when both receptacles contain their due quantities, the two receptacles are damped simultaneously, the materials being carried off and mixed together for roasting or passing into the grinding mill to be ground into cement.

Archimedean screws, enclosed in metal tubes of large diameter, are used to convey the finished cement to the machines, which weigh and deliver the cement to bags. The Automatic Weighing Machine Company, of Newark, N. J., make machines of this type which will deliver four to six sacks per minute.

STRENGTHENING CEMENT.

A curious fact about high grade mortar colors is that their use actually strengthens and improves cement and concrete work. The theory of this is that the impalpably fine and even grains of a mortar color like Ricketson's "Red Brick" Brand, fill in the pores of the cement so as to make it absolutely close and weather proof. To obtain this result it is necessary of course, that the mortar color itself be absolutely stable and unchanged by weathering, or the cement will soon lose its tough denseness. Ricketson's colors have stood the test of over 20 years exposure without a sign of a change.

A MILLION DOLLAR CONCRETE DAM.

Work on the concrete dam across the Peshtigo river at High Falls, Wis., is progressing rapidly. It was inspected recently by several experts, by officers of the Green Bay Traction company, the owner of the water power, and the Green Bay business men, the guests of President Frank Joslyn of Oshkosh.

Built according to the plans of D. W. Mead, professor at the University of Wisconsin and chief engineer in charge, the dam when completed will form an immense reservoir of 2,500 acres surface and produce nearly 10,000 horsepower, which quantity may be increased should the demand warrant the installation of additional machinery. This power represents a tremendous factor in the further upbuilding of Green Bay and manufacturing interests in the Fox river valley.

The dam will be completed by Jan. 1 next after which the machinery, which is being built by the Allis-Chilmers company at Milwaukee, will be installed. With the first spring freshets the reservoir is to be flooded, and this according to the calculations of Prof. Mead, will require seven days. Accordingly the power house will be in operation eight or nine months hence.

The total cost of the work of construction, it is expected, will exceed a million dollars. The greatest and costliest physical difficulty to overcome in the construction of the bed for the dam across the stream is the extreme hardness of the blue granite. The work is under the supervision of Supt. Robert Houston of the Bates & Rogers Construction company which is also doing extensive work for the Milwaukee road on its western extension and the Northern Pacific.

The total length of the dam will be 4,800 feet. The middle concrete part is 1,600 feet, with two earth dams of equal length at each end. At its highest point the dam will have a thickness of thirty feet at its base. The head when finished will be eighty-six feet.

NEW CEMENT TILE CATALOGUE.

One of the most complete and attractive catalogues which has appeared for a long time is the recent one of the Cement Tile Machinery Company of Waterloo, Iowa. It has a handsomely designed cover in three colors and is printed throughout on heavy enameled paper, bringing out to its full advantage the work of both the engraver and the printer. The frontispiece is a birdseye view of the extensive plant of this company at Waterloo, and is followed throughout the book with various detailed views of different departments, as well as portraits of the officers of the company. The reader goes from page to page in the books almost irresistibly. Even the illustrations of the familiar Schenk drain tile machine are worked up in such an attractive manner as to make them of absorbing interest. This machine is described in all its details, together with some general hints on the manufacture of cement tile and the entire subject of drainage. Other concrete machinery is also gone into quite extensively, for, as is well known, this company handles practically every kind of concrete machinery. One of its well known products is the perfection mixer, which is generally conceded to be one of the most reliable and satisfactory continuous mixers on the market. This machine is equipped in various styles to suit purchasers. The book, which comprises 64 pages, closes with some suggestions on the design of a plant for the manufacture of tile and other cement products, giving floor plans and perspective drawings. It is a book well worth having,

PRICES OF CEMENT IN KANSAS CITY.

Kansas City, Mo.—Cement that cost $1.25 a barrel in car load lots a week ago can be bought today (July 28) for eighty cents. Wagon loads of this same quality, delivered, are quoted at ninety cents. One week ago the price was $1.50. Those were the prices at noon, but no one was found who was willing to predict what they might be before sundown. All the price lists sent out for several days by practically every company have been marked "subject to change without notice."

Cement prices have fluctuated about once a year in

Kansas City for a long time, but nothing like the present decline has happened, the dealers say, since the mills in Kansas became a factor in the business.

NEW CEMENT MILLS TO BE BUILT.

Spocari, Ala.—Albert Wilson, of Montgomery, and W. C. Whittenburger and W. B. Moore, of St. Louis, are in the city looking after the affairs of the Alabama Portland Cement Company, of this city.

From these gentlemen it is learned that under the re-organization, the plant will be doubled in capacity and in operation in a few months. Massey Wilson, ex-Attorney General of Alabama, his brother Albert Wilson, T. W. Martin, Assistant Attorney General of Alabama, J. S. Pinckard and Cook & Laurie, of Montgomery, are the men who are now controlling the affairs of the company.

San Antonio, Texas.—A half-million-dollar cement plant is being built on the outskirts of the city. The buildings of the Alamo Cement Company cover two acres of ground and sixty-five men are now working upon them. The construction is of steel and iron, the frame-work being covered with sheet iron. The cost will be in the neighborhood of $500,000, embracing a tube well, kiln building, dryer building, motor house, power house, gas house and smaller buildings.

The plant will manufacture the cement from the material secured right on the ground, which is two and a half miles out River Avenue beyond Brackenridge Park.

The plant is on what is almost a solid hill of cement rock, the finest quality of rock and clay being at hand. The supply, it is figured, will last for 300 years. The company owns one Spanish section. Its own power is generated on the ground, and water is furnished by an artesian well.

Wilbur F. Allen, Chanute, Kans., has been appointed receiver for the Chanute Cement and Clay Products Co., Chanute, Kans. Ed. E. Danelley, a Chanute contractor applied for the receivership on the strength of claims against the company amounting to $4,038.91. Other Chanute creditors have claims with a total amount of $20,000. The plant is under construction and almost complete, about $250,000 to $300,000 have been expended so far for labor and equipment. J. T. Rustamier, contractor, Western Drilling Tool and Supply Co., M. R. Smith Shingle Co., Chanute Lumber Co., Chas. W. Brown all of Chanute, Kans., and Fredonia Portland Cement Co., are parties in the action against the company. The McClintick-Marshall Construction Co., Pittsburg, Pa., has filed liens in the district court against the plant for $4,400 and $900 for steel they have furnished. The Osborn Engineering Co., of Akron, Ohio, has the contract for designing and constructing the mill.

J. F. Townsend, Pres. of the company is in Europe on a trans-continental trip since six weeks. Chanute residents hold bonds amounting to $177,000. The company was capitalized for $4,500,000 in stocks and $2,000,000 in bonds. The proposed capacity was 3,000 bbls. daily.

Portland, Ore.—Officers of the Portland Cement Company, 608 Lumbermen's Building, Portland, Ore., expect soon to make an important announcement concerning the installation of a large plant at Oswego, Oregon, for the manufacture of cement. C. W. Nibley, of Salt Lake, one of the heaviest stockholders in the corporation, was in the city the other day in conference with his associates.

Originally the company was incorporated as the Portland-Oregon Cement Company, but more recently supplemental articles were filed in which the name of the corporation was changed to the Portland Cement Company. It is incorporated with a capitalization of $2,500,000. Several other Salt Lake capitalists are associated with Mr. Nibley in the ownership of the enterprise. Prominent Portland, Oreg., men also are heavily represented among the stockholders, among them being C. E. Ladd, J. N. Teal, Theodore B. Wilcox, J. C. Ainsworth, Walter F. Burrell, A. L. Mills and Tom Richardson. Aman Moore of Los Angeles, Cal., is President of the company.

Poughkeepsie, N. Y.—The American Cement Company of Philadelphia closed negotiations for the erection of $1,000,000 plant in Poughkeepsie for the manufacture of Portland cement. The company has purchased thirteen acres of land near the New York Central Railroad. Several farms about seven miles from the city have been acquired because of the presence of excellent cement rock on the property. Work is to be commenced at once.

That the Victor Portland Cement Company will in the very near future build in Los Angeles, Cal., a plant to cost eventually in the neighborhood of $1,500,000, is practically an assured fact. The contract for construction has been awarded to the F. O. Engstrom Company, and the plans have been drawn up by L. D. Gilbert and Aman Moore of Los Angeles, designers of the monster plant at El Paso, Tex.

The company has long intended to build, but only recently has Los Angeles been determined upon as the site. The reason for this choice is that the freights on the raw material from Victorville are much less than those on the finished product, and that Los Angeles itself offers the best possible market for the cement manufactured. The plant when in full operation will have a capacity of 3,000 barrels daily. Three kinds of cement, white, commercial and marine, will be produced.

The Ogden Portland Cement Company, in which Grand Rapids, Mich., and Chicago capital is largely enlisted, is building a plant on its property in Box Elder county, Utah. This is to cost $300,000 and will be of the most modern type as to construction and equipment. The plant will be producing Oct. 1 and have a capacity of 600 barrels daily. W. J. Bell, general superintendent for the Newaygo Portland Cement company, is the president and general manager of the Ogden company and will give its operation personal attention, although retaining his interest with the Newaygo company in the capacity of consulting engineer. A. T. Thoits, Harry K. Dean, John G. Gronberg and A. S. Hicks of Grand Rapids, Mich., are interested.

The Manitoba Gypsum company, Winnipeg, Man., whose plant was destroyed by fire a few days ago, has already completed arrangements for the construction of a new re-inforced concrete mill, designed to be fireproof. A contract was awarded yesterday to George H. Archibald & Co.

Philadelphia, Pa.—The Tidewater Portland Cement Company is being organized with a capitalization of $5,750,000, to build a plant at Union Bridge, Md., for manufacturing 1,000,000 barrels of cement and 200,000 barrels of hydrated lime annually.

The Osborn Engineering Co., Cleveland, O., have the contract for the construction of the plant for the

Arkansas City Portland Cement Co., located about 6½ miles east of Arkansas City, Ark. Construction work is to commence at once.

Mr. J. S. Herbert, chief engineer and general superintendent of Atlantic & Gulf Portland Cement Company, Ragland, Ala., reports that work is progressing rapidly. About ten teams and 1550 men are employed on excavating and concreting work. The drawings are out for the structural steel and bids will be received. P. S. Van Kirk Co., of Paterson, N. J., have the contract to build the plant.

The Kansas Gas and Cement Co., held a stockholders' meeting in Cottonwood Falls, Kans. The total stock of $300,000 was represented. The following officers were elected: G. W. Shaw, President, Strong City, Kans.; T. H. Grisham, Secretary, Cottonwood Falls, Kans.; H. H. Hallett, Treasurer, Las Veges, Kans. T. A. Wilson of Emporia, Kans., was appointed superintendent.

A proposition has been made to the commercial club of Hartshorne, Okla., by Capt. J. P. Grady, of McAlester, Okla., to erect a cement plant near this town. The business-men in Hartshorne have subscribed for $25,000 worth of stock and McAlester is expected to subscribe $50,000. The location of the plant will be within a mile of the railroad. The capacity of the plant will be 1,200 bbls.

Mr. R. J. Kellogg has been appointed construction engineer for the Cape Girardeau Portland Cement Co., Cape Girardeau, Mo. Mr. Kellogg just finished the construction of the plant of the Superior Portland Cement Co., Baker, Wash. Prior to his connection with the Superior Co., he was connected with the Pennsylvania Co., and Northampton Portland Cement Co.

The Panama Portland Cement & Development Company, incorporated, with a capital stock of $3,000,000, is planning to begin the construction of its proposed plant at Forkland, Ala., with daily output of 1,000 barrels of cement.

Mobile, Ala.—The big enterprise of the Mobile Portland Cement and Coal Company is attracting public attention, because of the visit here recently of Dr. Otto Gerlach, formerly chief chemist and manufacturer of the Iola Portland Cement Company. He is to personally supervise the installation of a 3,000-barrel cement plant at St. Stephens, Washington county, Alabama, and will conduct the factory when completed.

Pueblo, Colo.—A plant for the manufacture of cement from blast furnace slag, has nearly been completed in Pueblo. It is located south of the Minnequa steel works between the mills and the lakes.

Avery Leavitt, construction engineer of the Colorado Portland Cement Company, and a force of draftsmen have been in the city for nearly a month and several weeks ago actual construction was undertaken. Mr. Leavitt has opened offices in the Central block.

Nashville, Ark.—L. B. Palmer, who is in charge of the White Cliffs cement plant, near Nashville, is authority for the statement that his company is now preparing to install a modern plant of 3,000 barrels capacity per day, and resume operations. The plant now on the property is antiquated and worthless, except for junk, the boilers and large engine being all that remains of value.

This plant has been idle for many years, transportation and fuel being the obstacles in the way, but now that the Memphis, Paris and Golf railroad passes the plant, and gas is becoming available in this section for fuel, the large industry will soon be going.

The Oklahoma City Portland Cement Company has been incorporated, and will establish main offices in Oklahoma City. A plant will be erected at once at Hartshorn, Okla., by the Freeborn Engineering & Construction Co., of Kansas City, Mo. The capital stock is $1,200,000.

Officers of the new corporation are: C. B. Black, Oklahoma City, president; A. Bollenbach, Weatherford, vice-president; H. J. Cerwinsky, Hartshorn, second vice-president; D. W. Keller, Deer Creek, secretary; Elta H. Jayne, Edmond, treasurer.

Other stockholders are: O. W. Weiser and C. E. Toole, of Edmond; A. C. Farmer, A. F. Bimbford, Ed. L. Klein, L. S. Brown and W. W. DeLong, Oklahoma City; George Landrum, C. L. Scott, Weatherford; J. S. Dexter, C. F. Eberle, R. E. Lehman, Dr. J. F. Martin, Walter Collster, A. M. Van Volkenberg and Frank Roberts, of Deer Creek.

The company controls cement property at Ada and Reynolds, (Okla.), and contemplates erecting plants there at a later date.

"Between 40 and 50 men are working on the site of the Inland Portland Cement Company and more are being added daily," said F. C. Fiske, engineer in charge of the work, in a recent interview.

The Inland Portland Cement Company is building one of the largest plants in the west, on the Pend Oreille river at Metaline, Wash., the company being owned by F. A. Blackwell and eastern associates.

"To prepare the site for the factory it has been necessary to clear a large portion of ground of heavy standing timber," said Mr. Fiske. "Roads have had to be constructed and camp buildings erected. Owing to conditions of the location it has not been possible to employ a larger force of men, but after the preliminary work has been accomplished, the present force will be greatly increased."

Every effort will be made to have the plant in operation within twelve months and the finished product turned out. The Idaho & Washington Northern will connect with the plant.

Los Angeles, Cal.—The Sunset Plaster and Cement Company recently incorporated by Timothy Mahoney and associates, I. W. Hellman building, for $200,000, intends to erect a large mill for the manufacture of fireproof wall plaster and plaster of paris and cement in this city. The estimated cost of the investment is $125,000, and it will have a daily capacity of 200 tons. The company owns 900 acres in Ventura county, about forty miles from Los Angeles, which contains extensive deposits of gypsum of high quality. It will quarry the raw material and ship it to Los Angeles for treatment.

CONCERNING THE MILLS.

At a meeting of the board of directors of the International Portland Cement Company, Limited, in Ottawa, Canada the other day, the usual half-yearly dividend of 5 per cent was declared.

The Morgan Portland Cement Company was recently incorporated in Delaware with a capital of $1,500,000. Incorporators: N. Marcus, E. E. McWhiney, Philadelphia, Pa.; F. M. Shive, Wilmington.

Easton, Pa.—The Alpha Portland Cement Company

announced a 10 per cent increase in wages at the various plants of the concern recently. The order affects about one thousand men. The company says the condition of trade does not warrant the increase, but the additional pay is granted in consideration of the high cost of living.

Kansas City, Mo.—The Lumbermen's Portland Cement Company, whose plant is located at Carlyle, Kan., have placed order for their grinding machinery.

Pittsburg, Pa.—The Universal Portland Cement Company are making preparations for the installing of the additional machinery in their plant near here. They have placed an order recently for fourteen pulverizers.

Directors of the American Cement Company, Philadelphia, Pa., have declared the usual semi-annual dividend of 3 per cent, payable July 24 to stock of record July 10.

S. C. McCurdy has taken up his duties actively as general sales manager of the new Southeastern Portland Cement Company, with headquarters at El Paso, Texas. The new plant has just started its operations, and is making a standard Portland cement. The officers of this company are Carl Leonardt, president; Felix Martinez, vice-president; A. Courchesne, general manager, and O. J. Binford, secretary and treasurer.

Allentown, Pa.—Some 400 men, idle for the last five months, returned to work at New Castle recently, when the No. 2 plant of the Lehigh Portland Cement Company resumed operations. The company will produce 7,500 barrels of cement daily there.

Lindsay, Ont.—McKenzie & Mann have purchased the Raven Lake Cement Company's works at Raven Lake and have commenced repairing buildings and machinery.

Hanibal, Mo.—A strike of 1,000 foreign workmen at the Atlas Portland Cement Co.'s plant where riots occurred recently, was settled by the company agreeing to an advance of 10 per cent wages.

W. H. Kemler, of the Basie Products Company, Kenova, W. Va., writes us follows:

"We are now installing a modern rotary kiln plant for calcining lime, and will produce a wet process high calcium and magnesium hydrate under process, patent applied for. Our equipment has been contracted for with the Allis-Chalmers Company, all to be gas engine and electric drive, steel buildings and storage arrangement for several thousand tons of crude material. We also have in view the erection of annex plants for production of liquid carbonic acid, magnesium carbonate, barium salts and compounds and calcined refractory clays."

W. F. Cowham, president of the Southwestern States Portland Cement Company, and his associate, John W. Boardman arrived in Dallas, Texas, a few weeks ago. The object of their visit is to superintend the opening of their new cement plant. Local Manager B. V. M. La Rue, said that the big cement plant is all ready to begin work, and that Mr. Cowham's visit was purely for the purpose of discussing matters pertaining to the opening, and the manner in which the business should be conducted.

Mr. Cowham said that one of the principal objects of his visit was to observe the working of the three large 1,000 horse power gas producer engines, which have been installed to furnish power for the plant. Through a system of dynamos these three units will furnish electric power for the operation of the entire plant.

The output of the new plant, according to Mr. La Rue, will be about 3,000 barrels each day, and will be the third largest production of the plants owned by this company in the United States.

At receiver's sale July 25 Lewis Soller and Henry O'Loughlin, of Philadelphia, sold the plant of the Bonneville Portland Cement Company. The purchaser was Charles M. W. Keck, president of the Allentown National Bank, Allentown, Pa., whose bid was $350 above the bonded debt of $600,000. The floating debt is about $100,000 more. The failure of the Bonneville Company shows that the entrance of the Philadelphia politicians into the cement business was not profitable.

The plant, which was established by the late Amabel Bonneville, was bought six years ago by a company composed chiefly of Senator Penrose, Senator Durham, Senator McNichol and other Philadelphians, much of its output going into public works in Philadelphia.

On June 14, '09, the plant of the Monarch Portland Cement Co., Humboldt, Kans., held a stockholders meeting, which was attended by more than 350 of the stockholders. The day was the occasion for a double celebration, Flag Day and an eventful beginning of a commercial era for Humboldt, Kansas. The entire town joined hands to make the day a Gala day. The visitors were entertained in a fashion never before experienced by the visitors of Humboldt, Kansas. Entertainment of every character and a visit to the plant were on the program successfully arranged by the committees, which marked the deep interest the citizens have in this new enterprise.

At the business meeting which lasted several hours, addresses were made by O. N. Connet, Pres.; Wm. Keith, Sec'y.; and L. T. Barnes, Supt. The following directors were elected for the ensuing year: O. M. Connet, Wm. Keith, L. F. Barnes, Geo. V. Mathias, of Humboldt; A. C. Kreitzer, of Wichita; Ed. N. Sweet, Hutchinson; C. W. Peckham, Haven. The treasurer's report showed the company's finances in good condition, and the assests to amount to over $1,000,000.

The following resolution was passed by unanimous vote:

Whereas, That up to this time a large part of the organizing and building of the magnificent plant of the Monarch Portland Cement Co. has resolved upon its worthy president, secretary and engineers, Messrs. O. M. Connet, Wm. Keith, and L. F. Barnes.

Be it Resolved, That we, the stockholders, now assembled in annual session do hereby express to said Connet, Keith, and Barnes, our appreciation of their excellent work as evidenced by the splendid showing we have today seen on the company's property. Also by the splendid showing made in the treasurer's report which we have heard read here today.

Those who are closest in touch with the possibilities of the plant, believe that every dollar invested will be returned to them in dividends many times in the next few years, so that notwithstanding the fact that some of our cash has been invested away from home, Hutchinson will eventually be the richer for having been represented at Humboldt.

The Portland Cement Securities Co., of Portland, Ore, has been incorporated by Alex. Nibley, Aman Moore and J. N. Teal, with a capital of $250,000.

Chelsea, Mich.—Following a meeting of the directors of the Millen Portland Cement Company recently, a receiver was asked for the concern. The company gives its liabilities as $200,000, with $150,000 assets.

Mr. Felix Gunther, Jr., formerly manager of operation at the plant of the Lehigh Portland Cement Co., Newcastle, Pa., is now general manager of the plant of the Continental Portland Cement Co., St. Louis, Mo.

Mr. B. D. Hostetter, sales manager of the Ash Grove Portland Cement Company, Kansas City, Mo., resigned July 1st. Mr. L. T. Sunderland assumes the duties as sales manager assisted by Mr. Pollock.

Mr. George Nicholson, president of the Iola and United Kansas Portland Cement Co., stated in a recent interview: "This year more cement will be manufactured in America than any year in its history. I believe the output will be 57 million barrels this year." Thus the prospects for the industry are the brightest, but if the minimum price would be $1.00 per bbl. at the mill, then every manufacturer would wear a smile that would never come off.

According to these returns the total quantity of Portland cement made in Canada in 1908 was 3,495,961 bbls. of 350 lbs. net, as compared with 2,491,513 bbls. in 1907, or an increase of 1,004,448 bbls. or 40.3 per cent. The total quantity of Canadian Portland cement sold in 1908 was 2,665,289 bbls., as compared with 2,436,093 bbls. in 1907, or an increase of 229,196 bbls., or 9.4 per cent. The total consumption of Portland cement in 1908, including Canadian and imported cements, was 3,134,338 bbls. (of 350 lbs. net), as compared with 3,108,723 bbls. in 1907, or an increase of 25,615 bbls., or 0.8 per cent.

The big dredge of the Bronson, Mich., cement plant sunk the other day, and efforts are being made to raise it, which is a difficult job, as there is so much heavy machinery. What caused the dredge to go down, is not known but a theory is offered that a charge of dynamite to kill fish might have caused the accident.

Considerable ill feeling and strife exists at present in the packing departments of cement mills at Coplay, Pa., and several strikes have been declared. The packers for the American Cement Company at Egypt walked out several days ago and their places have been taken by foreigners but it is believed that the situation will be cleared and the old men will resume work in the course of a day or two. The packers employed in the mills of the Lehigh Portland Cement Comany at Ormrod and Fogelsville have received an increase of one cent per barrel and have resumed work although grumbling is still to be heard, the men seeking the same rate of wages that was paid before the cut, which was 63 cents per hundred bags. The present scale is 52 cents per hundred bags.

Manila, P. I.—As an index of the extent of the improvements that have been carried on in the Philippines during the past few years it is stated that upwards of 1,000,000 barrels of cement have been used for construction work in the islands for the erection of permanent buildings and works.

The plant of the Elk Cement and Lime company at Elk Rapids, which closed down May 31, because of an over-production, has resumed operations. More cement was shipped from the mill last week by rail than ever before since the mill was built. While the price is low the demand is strong.

The Gayner Engineering Company of Kansas City, has started suit against the Monarch Portland Cement Company for alleged breach of contract. The Gayner Engineering Company, it seems, had contracted to design and build the Monarch plant. On the ground that the work was not according to contract. the officers of the Monarch Portland discharged the engineers after paying them $10,000. The engineering company, however, alleges that the work was in line with the specifications and sued to recover the balance due on the contract.

Florence, Colo.—Tony Pietro, a young Italian employed at the Portland cement works this morning had a thrilling experience and one that he will not soon forget.

Pietro was tending the pug mill which connects with No. 9 kiln when the thumb of his right hand caught in the cogs of the driving wheel and before it could be released the lad was hurled into the shaft wheel and carried around, his body making four or five complete revolutions.

He was rescued by fellow workmen, but not until his clothes were torn from his bady and his thumb so badly injured that amputation was necessary.

County Auditor Buhrer, Detroit, Mich., who returned today from Wiarton, Ont., where he has been organizing and starting operations in the Crown Portland Cement Co., which he is president, says that his firm is not in the $25,000,000 Canadian cement trust, which was reported this morning as having been organized in Montreal.

"I predicted the trust some time ago," said Mr. Buhrer, "and I know that plans are probably on foot to control the large trade of the northwest, where considerable building in going on, but I guess our company will weather the storm. Our plant has been idle for several months, but we have just put 50 men to work, enlarged the storeroom and made certain other improvements so that we will have a capacity of about 1,200 barrels a day."

George W. Videan, of Detroit, is secretary-treasurer of the concern. Other Detroiters interested in it are William W. Whittier, director, and W. A. Gibson, timekeeper and storekeeper.

H. H. Ward, the general agent of the Texas Portland Cement Company of Dallas states that his concern has secured the contract to furnish 100.000 barrels of cement to be used in the construction of the causeway across Galveston bay. The contract was made with the A. M. Blodgett Construction Company of Kansas City and is said to be the largest single order for cement ever placed west of the Mississippi river.

Mr. Ward states that his company won out over 30 competitors who bid on the contract, the majority of them being Eastern concerns.

The contract for the erection of the new car barn and terminal station of the Maryland Electric Railways Company, Baltimore, Md., has been awarded to J. Henry Miller and the construction will begin in a few days. The building will be erected at the southeast corner of Druid Hill and Fulton Avenue and will be leased to the United Railways Electric Company. The Building will be constructed of steel and concrete. It will be 197'x 472', two stories high, and will cost about $250.000.

EXTRAORDINARY ANNOUNCEMENT

TO THE

Concrete Workers of America

We realize that a new era in the concrete machinery trade has set in.

We meet it half way. This is how we propose to open the third chapter of our connection with the concrete industry.

The concrete machinery business, like every other form of manufacturing, must get down to cheaper methods of selling.

The period of experimentation is past. There is no more question today about a Miracle Mold or machine being practical and workmanlike than there is about a farm wagon or a wheelbarrow.

The jobbing trade must take over the business of distributing concrete working machinery, as it has nearly all other products, so we are getting ready to handle our machinery through jobbers.

Up to this time we have felt that our business required that personal attention and interest which goes with selling by mail and through traveling men. It was pre-eminently a work of education.

Working on these lines, we have built up a big business. We have for years felt that we were entitled to our reputation as "the largest manufacturers of concrete machinery in the world," and our claim to this distinction has never been disputed.

We are not in position to complain. The public and the trade have given us a fair hearing and we have tried to give all a fair deal. But we now feel that the change in the method of selling concrete making machinery must inevitably follow the tendency in other lines and fall into the hands of jobbers.

Besides, all these years we have "taken our own medicine." We have urged men to go into the concrete industry and we have started thousands of young men into the concrete business, many of them with great success. But, what is more, we have been conducting from two to a half dozen separate contracting enterprises, making concrete products and carrying on contracts for large concrete jobs, in various sections of the United States.

This policy of "taking our own medicine" we have always felt was the basis of our success as concrete machinery manufacturers. Whatever else may be said, Miracle concrete working equipment has been practical. Our machines have done the business for us before they were offered to the public, hence they have been successful, and "Miracle workers" who bought their first concrete making outfits from us years ago are still in the "Miracle family."

Now that we realize that times are changing and methods must be made to conform, we believe we are the first of the leading manufacturers to announce this new policy. We have a large number of contracts outstanding granting exclusive territorial rights to make the Miracle Double Air-Space Block. These contracts are valid today, and, together with the Miracle" name as a trade mark, they are worth many thousands of dollars to us and to the holders of these contracts also.

As soon as our plans can be carried out we will inaugurate the practice of

Manufacturing for the Jobbing Trade

Details of this will be announced later. In the meanwhile we are going to clear out our stock at practically manufacturer's cost.

At Manufacturing Cost

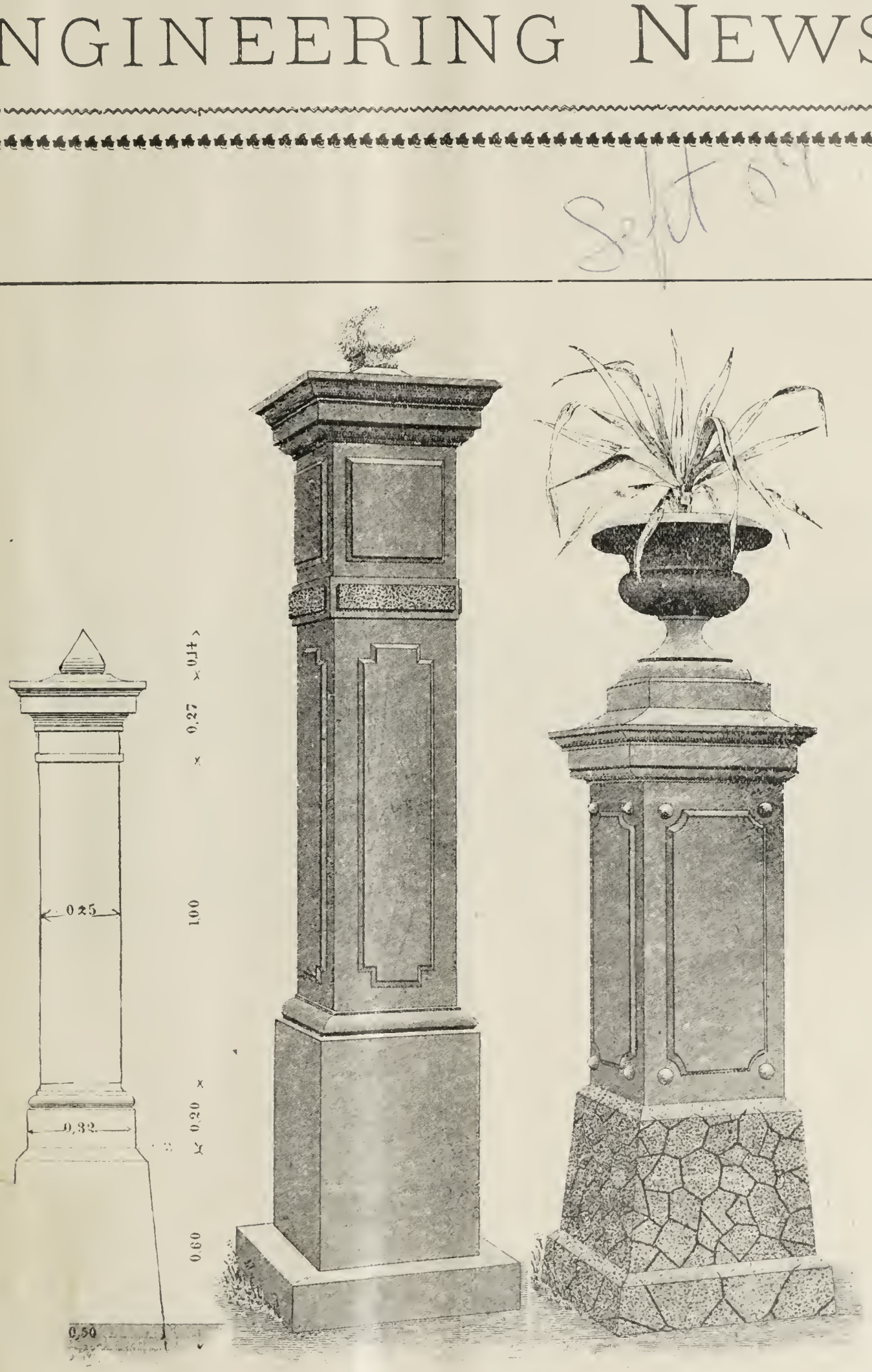
We give herewith a list of Special Clearance Discounts based upon the Miracle 1908-9 Catalog, all subject to previous sale.

If you do not have either of the catalogues above referred to, ask for Catalogue "L."

Aug. 10, 1909.

Miracle Pressed Stone Co., Department L **Minneapolis, Minn.**

CEMENT
.....AND.....
ENGINEERING NEWS



Concrete Pedestals and Vase.

CEMENT AND ENGINEERING NEWS

[PUBLISHED MONTHLY]

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JOHN F. WALDRON - - - - Advertising Manager

CHICAGO SEPTEMBER, 1909.

DEFECTIVE CONCRETE STREET PAVING FOUNDATIONS.

Next to defective concrete work in building construction with which municipal corporations, and private individuals have to contend, is the scarcely lesser evil of bad work on street pavements, especially on concrete paving foundations for brick and asphalt wearing surfaces. In order to produce good foundations, the concrete should be machine mixed always, and with sufficient cement to bond the aggregates together. The materials entering into the composition of the concrete for street foundations, are usually good enough to produce sound work, if done according to City specifications. When, however, the City inspector is lax in his supervision, or is positively dishonest and permits bad mixing, skimping of cement, etc., bad results are sure to follow. The Barber Asphalt Company has lately been called to account, in this respect, by property owners on certain Chicago streets. This is a step in the right direction, showing that the long suffering and meekly submissive tax payer is beginning to think and act for himself. As a rule when an individual decides to spend several hundred dollars for a commodity, he has the choice of dealers in that commodity; is able to investigate their integrity, and is in a position to a considerable extent to judge for himself whether he is getting his money's worth or not. Not so, however, with the property owner who is assessed for street paving. He is suddenly notified that his share for the pavement of a street on which he owns property, will be $300, for perhaps only a short frontage. Usually this is the last he hears or knows about the transaction. Perhaps after the pavement has been down for a few months patches a yard square peel off the surface, and he realizes that he has by no means received his money's worth, but his $300 must be paid in regular installments just the same.

The actions of the citizens in one section of the City of Chicago, in calling paving contractors to account for defective street paving work, is being followed up by similar action in other parts of the City. When City inspectors and paving contractors, get together and mutually agree on skimping materials, and otherwise cheating in public work, they should be severely punished. This sort of thing is dealt with in the right way in some of the Eastern States. Under the laws of Massachusetts, a contractor found skimping material on public work is treated as a criminal, is arrested and prosecuted in the criminal courts, and is subjected to fine and imprisonment, together with the inspectors and superintendents employed on the work who have guilty knowledge of the matter. The board of local improvements of Chicago has reached the conclusion that hand mixing of concrete is unsafe, and unreliable, and that hereafter all concrete on such work must be machine mixed. This is a very proper stand to take as the machine mixed concrete is much more reliable and the work cannot be as readily slighted as in hand mixing.

Contractors for public work are paid for good work only and where good work is not produced it is through some negligence on the part of the City officials directly in charge of same.

Philadelphia. Pa., Sept. 5.—Certain manufacturers who had been looking for another advance in the price of cement yesterday, as a result of the meeting held Friday at the offices of the North American Portland Cement Company in New York were disappointed. No such revision in prices was made. Moreover it was stated yesterday by an official of the company that in view of the fact that the busy season will be over in about 60 days that no further advance will probably be made this year.

SOME EXTENSIVE CONCRETE FLOOR WORK.

The H. N. Leighton Co. general contractors, Minneapolis, Minn., poured the reinforced concrete floor this week for the new Roman Catholic pro-cathedral at 16th st. and Hennepin av. This floor is of exceptional size in every way, the floor panels being 20x24 feet each, between girders 40 feet long by 4 feet deep and 18 inches wide. This floor is of reinforced concrete construction, and has an area, 80x80, under the dome and 80x150, in the auditorium. The floor is said to be the largest in the world, and has 23,000 square feet of space. Wm. Pierce Cowles, of Minneapolis, is the designing engineer.

Another job of reinforced concrete type, is in the vicinity, being the floor of St. Mark's Episcopal church, at Hennepin av. and Oak Grove st., Pike & Cook being the general contractors. This floor includes some intricate and complicated work for the sanctuary and organ loft, with a kind of hanging loft included, as well as several different levels of flooring. This is also designed by Wm. Pierce Cowles.

The price of cement in Kansas City yesteray was increased from eighty cents to $1.08 a barrel by the manufacturers. For some time the cement market has been depressed. The advance of twenty-eight cents a barrel announced yesterday is declared by the manufacturers to be the result of an increased demand.

"All I know is that we have advanced our price twenty-eight cents a barrel," George E. Nicholson, president of the United Kansas Portland Cement Company, said this morning. "This price is effective in all Kansas City territory. I know nothing whatever concerning the action of other manufacturers. We had cleaned up our stocks and made the increase in price because of the increased demand for the product."

The increase is said to have been decided on at a meeting of the representatives of cement manufacturers in Kansas City yesterday afternoon.

The Dexter Cement Company, of Nazareth, Pa., held its annual meeting recently at the office of the company at the works. The report was very encouraging, and the stockholders were pleased with the financial condition of the company. All the old directors were re-elected.

GREAT BRIDGE PROJECT AT CLEVELAND.

Largest Arch in the World is Being Built for Cuyahoga County and Will Be Completed Next Year. Alma Cement Being Used.

A noteworthy engineering work is in progress at Cleveland, Ohio, which involves the construction of the longest concrete arch in the world. The bridge will span the Rocky river gorge just west of the city and the main arch will be 280 feet in length, which is 47 feet longer than the great arch in the Walnut Lane bridge at Philadelphia.

The bridge is being built for Cuyahoga county by Schilling Bros., of Columbus, Ohio. From the top of the central span to the surface of the water there is a distance of about 100 feet.

The new structure is to be built 10 feet to the north of the present bridge. Instead of wooden staging, steel is to be used. Much of this will be set in place this season though the central arch will probably not be poured before next spring.

The contractors have been at work on the structure for some months and have just completed the foundations which go down a number of feet to bedrock. The bridge was designed by A. B. Lea, the county engineer, and his bridge engineer, A. M. Felgate. A large force of men are now at work but it is not believed that the structure will be ready for use before the end of the year.

The total length of the bridge is 708 feet. It will have a 40-foot roadway and 8-foot sidewalks at each side.

The main arch is to be divided longitudinally into two ribs, each 18 feet wide transversely. Steel car rails will be imbedded in concrete for use in the future. The main roadway will be paved with brick, concrete being brought to subgrade ¼ inch of asphalt being used before the bricks are set.

Standard engineering practice has been adhered to in the designing of the approaches. The main arch and the centering for its erection, together with the two main piers, will require especial care. Careful calculations have been made and the best engineering science has been resorted to in determining stresses. Diagrams and computations have been carefully checked and these have been referred to other experts.

Factors of safety in materials have been investigated in accordance with the best engineering practice. The concrete in the main arch will not be reinforced as it is used to resist compressive stress only. Concrete for the arch ring and where steel is used for reinforcing is to be proportioned for mixtures of one to six, sand and stone, properly graded to fill voids.

This will develop a minimum compressive resistance at 2,000 pounds per square inch on a 12-inch cube thirty days old. In three months it is computed that the resistance should increase to 2,800 pounds and in six months it should register 3,800 pounds to the square inch. As the stress is designed for 600 pounds it is believed that the factors of safety will be readily cared for. It is likely, however, that the engineers will require the contractor to furnish a concrete of a certain compressive resistance in addition to the ordinary specifications for cement, sand and stone.

In erecting the main arch the centers will be loaded so that the distortion due to eccentric stresses will be reduced to a minimum. This feat will be accomplished by depositing blocks of concrete simultaneously on each side of the crown. This work will be covered by special plans.

The design is one of dignity and it is believed that when it is finished it will be one of the most attractive bridges in existence. Considerable work was done in testing foundations for the bridge before the contract was let. It was found that it would be feasible to rest the piers on solid shale which has a high bearing capacity. The bases of the main pier have been designed so the bearing does not exceed 6½ tons to the square foot. Ample provision is made for the thrusts due to the arch by the weight of the piers themselves and the backing of the shale banks.

The bridge as it will look when completed. Alma Portland Cement being used exclusively.

Two subways for wires and pipes are to be provided. Each will be 4 by 12 feet in size. Water pipes will be laid for future generations, while the various telephone and telegraph companies will install wires on the same basis. This work will all be done before the bridge floor is laid.

The contract for the steel falsework, which is to cost in the neighborhood of $25,000, has been let to the Interstate Engineering Company, of Cleveland. Much of it has already been delivered. Alma Portland cement is being used on the big job, some 25,000 barrels being required for its completion. Clean, sharp river or lake sand is specified. Slag or crushed limestone may be used in the footings and arch returns, while for the main arch clean limestone or other hard stone up to a ton in weight will be used.

This is the third largest masonry arch ever attempted.

The Hardening Process of the Calcareous Hydraulic Cements.

BY DR. W. MICHAELIS, SR.

For about 150 years men of science endeavored in vain to explain the hardening process of the calcareous hydraulic cements. The cause of the futility of their efforts is to be found in the first place in the fact that the reactions, which these calcined products undergo, upon coming in contact with water, do not go on in well-defined proportions, but in uncertain and varying ratios; furthermore, it is due to the phenomenon that the part of the reactions most essential to the hardening offers such obstacles to the completion of the process, that the reaction can practically never come to a finish, so that the hardened product invariably consists of a mixture of decomposed material and of material which remained unaffected. This explains the difficulty or rather impossibility of ascertaining by chemical analysis definite products of the reactions.

Sixteen years ago I stated (Chemiker-Zeitung 1893 Vol. XVII, p. 982) "that the calcareous hydraulic cements owe their hardening mainly to the formation of colloidal calcium hydro-silicate, because calcium silicate is absolutely insoluble in water." This definition I wish to correct and to say "because calcium hydro-silicate is difficult to dissolve and because it possesses too great a velocity of formation, that is to say, because it forms too rapidly out of its component parts."

If pure silica sole (a clear solution of silica in water) is poured into lime-water of a dilution of 1:120.000 (1 part by weight of calcium hydrate to 120.000 parts by weight of water), the mixture of these clear solutions becomes opalescent. If the silica sole is poured into lime-water of a concentration of 1 : 60.000, a suspension immediately becomes visible upon agitation of the liquid. In lime-water of a concentration of 1 : 30.000 a flocculent precipitate, a hydrogel, is formed at once.

Whenever two bodies in solution come together and unite, no matter whether directly or after previous chemical exchange, the following may happen, in accordance with the general rules established by the Russian scientist P. P. von Weimarn as the result of his investigations of the Laws Governing Chemical Reactions:

1. The formation of the solid state goes on very slowly in a slightly over-saturated solution. In this case well-formed, large crystals are obtained, which sometimes require many years for their formation. The more slowly crystallisation progresses, the larger the crystals grow as a rule.

2. The formation of a solid body proceeds quickly from an over-saturated solution: the product, however, is not very difficult to dissolve. In this event, precipitation results usually in clusters of needle-shaped crystals. These latter, therefore, are of common occurrence. The crystallisation of gypsum, for instance, is a good illustration. If gypsum is allowed to crystallize slowly in a slightly over-saturated solution, it forms large crystals; however, crystallizing quickly from solutions excessively over-saturated, it forms small needle-crystals.

3. The formation of the solid body may be brought on quickly from an excessively over-saturated solution and the product may be difficult to dissolve. Then we obtain coagulation, that is to say jelly-like formations or hydrogels, briefly colloids, which means bodies of the consistency and of the physical properties of glue.

In this last described condition the compound of silica and calcium hydrate is always obtained at low temperatures, that is to say as amorphous calcium hydro-silicate, which is called a hydrogel in the wet state and a gel in the dry state, after loss of water by evaporation or by absorption. At 90 degrees Celsius and above, crypto-crystalline meta-silicate is formed (for instance plombierite, described by Daubree, sand-lime products hardened under high pressure, by Michaelis, meta-silicate, described by Dr. Ludwig). Chemical composition $CaSiO_3+2$ aq. At from 700 to 900 Celsius macro-crystals of the composition CaH_2SiO_4+4 aq. (as described by Robert Bunsen) are formed.

At the Stockholm Congress of the International Society For Testing Building Materials in 1897 I exhibited finely powdered crystal of quartz transformed into hydrogel by lime-water at 100 degrees Celsius.

What I attained by high temperatures at that time, I accomplished in the meantime by increased fineness of the powdered crystals of quartz, namely by using a powder the grains of which were of a diameter of considerably less than one micro-millimeter (the twenty-five thousandth part of an inch). This fineness is obtained by grinding a very small quantity of a fine powder in a clean, polished agate mortar for a sufficient length of time; for instance by grinding 20 milligrams for an hour. Such preparations are laborious of course, but are essential for experiments like the decomposing of hydraulic cements by large amounts of water or lime-water after the process practiced by me for many years.

If powdered quartz of this fineness is agitated with distilled water, a portion of the very finest powder remains in suspension, because the grains increase their volumes by absorption of water to such an extent that they float. If this milky suspension is boiled for several days, whereby the evaporated water has to be replaced from time to time, silica hydrogel is obtained.* If lime-water is added to the suspension of finely powdered quartz in water in such amounts that 1 part by weight of calcium oxide is present to 3,000 parts by weight of water, coagulation sets in at once under formation of a bulky flocculent precipitate of calcium silicate hydrogel.

That this coagulation is not merely brought about by surface-attraction can be proven by treating the hydrogel with dilute hydrochloric acid and subsequent filtering. Then the unchanged cores of the minute grains which constituted the quartz powder remain on the filter, while the clear filtrate contains soluble silica, that is to say, silicic acid or better silicium dioxide. The three so-called hydraulic factors of all calcareous hydraulic cements, namely silica, alumina and iron oxide, are always acids, because they act as strong acids at high temperatures and as feeble acids even at low temperatures in the presence of calcium oxide which has strong basic properties at all temperatures. All three of them, however, have amphoteric character, which is known for some time so far as aluminum oxide is concerned, but is almost unknown of the silicium dioxide. For this reason I propose to distinguish, according to the chemical properties, between silicic acid and silicium dioxide, aluminum acid and aluminum oxide, iron acid and iron oxide (this iron acid Fe_2O_3 must not be con-

*The plasticity of clays is principally, if not entirely, based upon their contents of colloidal silica. The process of putrefaction, to which clays are frequently subjected, effects an increase of the percentage of colloidal silica by hydration of the finest quartz powder, especially in the presence of small amounts of alkalies, which dissolve silica and form "soles," or with the assistance of ammonia, which is always formed in the course of this process.

ounded with ferric acid FeO_3). Silicic acid and alumi- um acid become stronger acids in proportion to the in- rease of temperature; at the highest temperatures luminum acid is even a stronger acid than silicic acid.

The latter remark is well worthy of consideration for nineralogists, who believe, in ce..ain minerals, chem- cal compounds to exist in which silica is an acid and lumina a base. I consider such "compounds," at least n most cases, to be mixtures of two fused acids, namely ilicic acid and aluminum acid. which solidified upon ooling.

In order to determine the influence of varying phys- cal conditions and of the size of the grains of pieces of quartz or of crushed or finely ground quartz with egard to the reaction of lime-water or pure water upon t, the following tests were made:

a) A transparent crystal of quartz weighing 9.024 gram with highly polished faces was placed in a stiff paste of chemically pure calcium hydrate contained in a large platinum crucible and heated in an autoclave at a temperature of 180 Celsius for 48 hours. Upon cooling, the lime-paste was removed and the crystal washed with dilute hot hydrochloric acid, then with a hot solution of soda in water and once more with dilute hydrochloric acid and water. Now it was dried and the weight found to be 9.0157 gram. The faces were just as highly polished as before the experiment. Ac- cording to the loss of weight the amount of the dis- solved silica was 0.0083 gram, while the direct de- termination of the soluble silica showed 0.009 gram, that is to say 0.1% of the quartz used for the experi- ment.

b) Another crystal of quartz, likewise chemically pure, but with a ground surface, which, when magnified 50 times under the miscroscope, did not show grooves, was treated in the same manner. In this case 12.7945 gram showed a loss of weight of 0.0313 gram, that is to say of 0.25%.

c) Fused quartz weighing 8.0917 gram from the firm of W. C. Heraeus with a perfectly smooth surface, which, however, had a clouded appearance rather than a high luster, showed, upon a similar treatment, a dull surface and lost in weight 0.0132 gram, hence 0.16%.

d) A pure transparent crystal of quartz was trans- formed into a powder which left no residue on the 100 mesh sieve (100 meshes per lineal inch) and 30% on the 200 mesh sieve. This was mixed with lime paste in such proportions, that the mixture contained 92 parts by weight of powdered quartz to 8 parts by weight of calcium oxide. This plastic dough yielded, upon heating for 24 hours at 180 Celsius in an autoclave, a petrified mass, which chemical analysis proved to contain 11.433 parts by weight of soluble silica. Thus 12.4% of the quartz used for this experiment were converted into soluble silica.

e) The same quartz crystal was pulverized so finely (only 20 milligrams were ground at a time for one hour) that the largest grains measured less than one micro-millimeter. This powder, stirred up with 6 quarts of distilled water, resulted in a milky liquid in which, owing to direct water absorption, part of the quartz powder was kept in suspension for many days. After being boiled for several days, whereby the evaporated water had to be replaced from time to time, gelatinous silica was the result. Quartz silica in so fine a state of subdivision, therefore, combines directly with water and yields colloidal silica even at low temperatures. more readily of course, and more bulky flakes result, at the boiling point of water.

It is well-known that a definite separation of quartz silica from amorphous silica is impossible. For in- stance, a solution of soda slightly dissolves finely pul- verized quartz.

At the thirty-first annual meeting of the Association of German Portland Cement Manufacturers (in 1908), Dr. Cabolet of Hemmoor stated that in his experiments in which commercial Portland cement was acted upon by large amounts of water, for instance 1 part by weight of cement to 500 or 1,000 parts of water, swell- ing of the grains of the cement powder, that is to say formation of hydrogel, commenced only, when the lime- solution, ensuing from the decomposition of the cement by the water, showed a concentration of 1:3300, in other words that a certain amount of calcium hydrate had to be dissolved in the water before colloids were formed.

It was, therefore, of great interest to ascertain the smallest amount of calcium hydrate the water was re- quired to contain in the case of silica, that is to say, to determine what minimum concentration formed the limit for the formation of colloidal calcium hydro-sili- cate. This object was attained in the following way: Of the commercial silica half-hydrate (a preparation known as silica via humida parata sicca, containing from 12 to 13 per cent of water)* an amount equal to 1 gram silicium dioxide was weighed off. This light, finely divided powder was agitated several times a day with about one liter of lime-water of five different concen- trations, namely with lime-water containing 1 part by weight of calcium oxide to 5230, 3860, 1630, 1340 and 866 parts of water. Each of these solutions was al- lowed to act upon the silica for 90 days. The total amount of calcium oxide adsorbed in the course of this treatment was 1.0253 gram. But even then the adsorb- ing power was not completely exhausted, as during the last two weeks still 0.01613 gram of calcium oxide were adsorbed out of the last, almost saturated, lime-solution. Hence a hydro-silicate was formed which contained 10 molecules of silica to 11 molecules of calcium oxide, that is to say slightly more lime than required for a mono- calcium hydro-silicate.

During the first treatment, with lime-water of a con- centration of 1:5230, the calcium oxide adsorbed by the silica amounted to 0.072 gram. No visible swelling occurred in this case. The solution showed, after ad- sorption had taken place, a concentration of 1:12.000. After the second and third treatment 0.612 gram of calcium oxide was found to be adsorbed, whereby the fine particles of the powdered silica had considerably increased in volume by swelling. The remaining lime- solutions had a concentration of 1:9160 an 1:9870. By the fourth treatment 0.325 gram was adsorbed; the lime- solution which remained was 1:1350 and the remaining solution after the fifth treatment showed a ratio of 1: 878. Thus the limit at which swelling occurs in the treatment of powdered silica with lime-solution lies be- tween the concentrations of 1:10.000 and 1:12,000. while, as we saw in the beginning, formation of hy- drogel in the case of silica in solution took place at a concentration as low as 1:60.000.

If one gram of finely pulverized Portland cement, of which one cubic centimeter weighs about 0.8 gram, is agitated with two liters of distilled water, boiled im- mediately before use, the free sulphuric acid of which must be neutralized with a cubic centimeter of satur- ated lime-water (the commercial aqua distillata contains as a rule a small amount of chlorine, calcium oxide and sulphuric acid and has a slight acidous reaction), water is adsorbed by the cement: however, no swelling becomes

*As hydrated silica, upon drying out, shows a continu- ous loss of water, genuine hydrates of it, do not seem to exist.

visible, no hydrogel is formed. 0.336 gram of calcium oxide are found in solution, that is to say 0.168 gram per liter. This concentration, 1:6000, is not sufficient for the formation of hydrogel.

Upon frequent agitation for 6 or 8 weeks of one gram of cement with twice the amount of water, 4 liters, whereby likewise great care was taken to prevent adhering and sticking together of the minute grains, 0.402 gram of calcium oxide was found to have gone into solution hence 0.1005 gram per liter. This represented a lime-solution of 1:10.000, in which swelling could not take place. In the former case 53 per cent, in the latter 64 per cent of the total amount of calcium oxide contained in the cement went into solution. Consequently nearly mono-calcium compounds remain, which are difficult to decompose by water and more so if the water contains calcium hydrate in solution. The lower the amount of lime in the calcium hydro-silicate, calcium hydro-aluminate and calcium hydro-ferrite, the more firmly the lime is retained by the acids. If now the finely powdered cement of the last two experiments is allowed to settle, after prolonged treatment with a large amount of water, which decomposed it, but did not cause formation of hydrogel on account of the lime-solution being too weak, and if the clear lime-solution is poured off and replaced by a more concentrated solution containing the same amount of calcium oxide, for instance by 300 ccm of saturated lime-water, formation of hydrogel in large flakes results immediately upon agitation of the previously decomposed cement. A certain, but small amount of calcium oxide is adsorbed by the decomposed cement out of the concentrated lime-solution. This amount, however, is only a small percentage of the material subjected to the experiment. Of the from 33% to 40% of calcium oxide extracted from the cement by the treatment with water, only from 3% to 5% are absorbed again. This shows that for the formation of colloids only a very few per cent of calcium oxide are required, a fact which must be well borne in mind for a clear understanding of the hardening process.

Opponents to my theory argued that Portland cement treated with so large an amount of water no longer remained Portland cement. To this I will reply that a cement is decomposed in any event, hence does not remain the original product, no matter whether acted upon by an equal amount or by a thousand times larger amount of water. Only by the virtue of this decomposing process it is able to harden and to become a cement, that is to say a binding substance, a "mineral glue." Of course, the small amount of water used in practice for gauging cement decomposes it only partially; only part of the cement powder, the very finest particles and the surface of the larger grains are acted upon at all. The larger the amount of water, the more completely a cement is decomposed, if care is taken that the grains do not stick together and become enveloped in the hydrogel formed at once by the decomposition of the smallest particles. Even if a thousand times as much water as cement is used, it can be observed that the inside of minute cement grains remains unaffected, because it is protected from the water by the hydrogel surrounding it, which latter results from the decomposition of the outside of the grains. For this reason it is well-nigh impossible to determine by chemical analysis the composition of the hydrates formed.

If the decomposed Portland cement of the last described two experiments, after settling at the bottom of the flask, and after decantation of the solution containing the extracted lime, instead of being agitated with a saturated lime-solution, is allowed to remain at the bottom and if the concentrated lime-water is carefully poured upon it without disturbing the sediment, the grains of the latter do not swell to the extent of forming large flakes, but are cemented together owing to the adsorption of lime. The brown color of the sediment turns lighter and lighter and finally resembles pure calcium hydrate, that is to say it becomes as white as snow.

The hydrates of alumina and iron oxide with 3 molecules of water (R_2O_3, $3H_2O$), if agitated with saturated lime-water, yield crystalline precipitates as a rule, because the compounds which result, namely tri-calcium hydro-aluminate and tri-calcium hydro-ferrite, form slowly. They are minute thin hexagonal plates. In the case of excessively over-saturated solutions, also hydrogel may result, that is to say colloidal calcium hydro-aluminate and calcium hydro-ferrite. The tri-calcium hydro-aluminate as well as the double compound of the latter with 3 molecules of calcium sulphate are almost insoluble in concentrated lime-water. Only the highest hydrates of alumina and iron oxides are capable of hardening with lime-paste. The de-hydrated oxides, the mono-hydrates and di-hydrates do not harden with it, or harden so slowly that practically no advantage can be derived from this process. In filtering the clear diluted lime-solutions in the course of the experiments above described, namely after treatment of Portland cement with a large quantity of water, a person can not fail to observe, on account of the slow filtering, that the solution passing through the filter is not pure lime-water, that is to say not a genuine solution, but a sole. This must be ascribed to the fact that owing to the small amount of alkalies in Portland cement (on an average 0.8 per cent), alkali-silicate goes into solution at the same time with the lime. This, of course, happens only in the event of lime-solutions so diluted that the limit. at which formation of hydrogel begins, is not reached. However, upon addition of a sufficient amount of concentrated lime-water to the clear filtrate until half-saturated lime-water is obtained, opalescence sets in and, upon further concentration of the lime-water, the amount of silica carried into solution, although very small, is precipitated in flocculent form as colloidal calcium hydro-silicate.

Thus, through the decomposition of Portland cement by so large an excess of water, calcium oxide is extracted from the cement, which, in the calcined state, represents an over-saturated solution of lime in a mixture of various fused compounds that solidified upon cooling; thereby the amount of the acid constituents, that is to say of the anions, or rather formers of anions, has been increased in the insoluble part, so that we may consider this hydrated residue the electro-negative part and the calcium oxide the electro-positive ion. Upon sufficient concentration of the lime-solution, the calcium oxide, the cation, travels to the anions, or both ions travel one to the other. As they combine very rapidly and as, furthermore, the compound formed is almost insoluble, formation of colloids is the result in accordance with the rules of von Weimarn referred to in the beginning.

That the concentration of the lime-water in this case must be 1:3300 before formation of hydrogel takes place, whereas for silica in solution a concentration of 1: 60,-000 and for very finely pulverized silica 1: 10.000 were found to be sufficient, is due to the counteracting influence of the alkalies. These act in opposition to the lime, because they form soles, that means carry the silica into solution, if the water contains a certain small amount of alkalies. The calcium hydrate, on the other

hand, is the most effective means of precipitating silica and of converting it into hydrogel and, in the course of time, into a gel. Moreover, the hydrolysis has to be overcome in the case of the reaction of 1000 parts of water upon 1 part of cement.

A Roman cement of excellent quality, the natural cement from Peissenberg, which contains 23.9% of silicic acid, 9.7% of aluminum acid, 4% of iron acid and 47.2% of calcium oxide, besides a small amount of gypsum and other ingredients, was agitated with water in the same way as the Portland cements formerly described. After a prolonged treatment of one gram of this cement with 3000 ccm of water, 8.4% of calcium oxide, that is to say 0.084 gram, were found to have gone into solution. After this decomposition had taken place, the insoluble residue was agitated with a lime-solution containing 0.28 gram of calcium oxide per liter. Yet, no formation of hydrogel became noticeable and no lime was adsorbed. However, upon being agitated with lime-water, containing 0.4816 gram calcium oxide per liter, considerable swelling occurred accompanied by adsorption of 0.0504 gram of calcium oxide. Hence, only an amount of lime equal to 5% of the original amount of cement was adsorbed.

(To be continued in next issue.)

THE UNION SAND AND MATERIAL COMPANY

The Union Sand & Material Company of St. Louis, Mo., owners of the St. Louis Portland Cement Works, have recently purchased the Kansas City Portland Cement Works which is located on the Santa Fe Railroad near Kansas City, Mo. This mill produces 600,000 barrels of K. C. Portland cement annually and was designed by the Freeborn Engineering & Construction Company, Kansas City, Mo., A description of the plant follows:—

It is located at the base of a high bluff composed of alternate strata of limestone and shale.

Tramway tracks lead from the base of quarry to the crusher building, cars being conveyed to the inside and dumped. The building is located on the side of the bluff on a bench quarried out of solid rock, built of concrete, and is 100 feet above the center of the main building. The crushed rock and shale pass by gravity from crushers to the dryers, which are located in a separate dry house, built on a bench below the crusher building. Below the crusher building are located the dry storage bins. These bins are built of concrete and have a capacity of 900 cu. yards. The tops of these bins are built to a level with the floor of the dryer building, and extend partially under it. The crusher building is equipped with two gyratory crushers, which are operated by electric motors. In the dry room are two rotary dryers, each 60 ft. long and 6 ft. in diameter. Dry shale storage is provided for with a bin built beside the rock storage bins. The capacity of this bin is 300 cu. yds.

Special weighing cars are operated on narrow gauge tracks which extend into the dry material bins from the edge of the bluff at the bottom or which is located the main plant. This track is all under cover and the man in charge at this plant has telephone connection with the chemical laboratory. The main mill building is 100x530 ft., and is 30 ft., in height to eaves. The foundations of this building are all of concrete, the superstructure being steel frame, sided with 2 inches of 1 to 3 cement mortar, laid on expanded metal. A concrete floor is laid throughout this building.

Eighty per cent. of the power used in the entire plant is supplied directly by the machines, and the other twenty per cent. is transmitted electrically. The power plant occupies a space of 110x100 ft. in the main building, and is divided from the remainder of the interior of this building by dust proof walls, constructed in the same manner as the outside walls.

The engine room contains two 1,000 h.-p. cross-compound condensing straight Corliss engines and three 200 k.-w. 440 volt, three-phase, alternating-current generators, furnished by Allis-Chalmers Company of Milwaukee, Wis., two of which are directly connected to a 300 h.-p. four-valve engine. The third being held in reserve, is connected by belt to a main line shaft. The engines are all operated condensing.

Water is supplied to the plant from a pumping plant located on the river bank above high water mark. Here centrifugal pumps are used, operated by Allis-Chalmers electric motors. The bottom of the pump pit is below extreme low water mark. Water is siphoned into the pump pit through two 14-in. pipes, a small air pump being used to start the flow.

F. L. Smidth & Co., 50 Church street, New York, N. Y., installed their kominuters in this plant.

The raw materials machine room contains six Jeffrey hammer mills, and six Allis-Chalmers tube mills, all being belted to the main line shaft extending through the room. In addition to screens built in these mills, the materials are passed through rotary screens, the tailings of which are passed back to the hoppers by bucket elevators.

The product of the raw material tube mills is raised by bucket elevators to Caldwell screw conveyors, which deliver same to the housings of the kilns in the adjoining kiln room.

The kiln room is 100x210 ft., and contains four 8x125 ft. rotary kilns, and three 6x60 ft. rotary clinker coolers. Four kilns are set in pairs, with one housing to each pair. The kilns are fired by oil, at three pounds pressure, the Green low pressure system with blower and large nozzle being used. Each kiln is driven separately by a 30 h.-p. variable speed motor. Rotary coolers are also each driven separately by 30 h.-p. variably speed motors. Clinker is delivered by a bucket elevator from the kilns to coolers. Coolers discharge into one-yard, side-dump, ball-bearing cars, which are raised to an elevated track by a motor driven freight elevator.

The clinker storage bin, built of reinforced concrete, has a clinker capacity of 50,000 barrels. The finishing room is 68x126 ft. in size, and contains 14 Bradley Griffin mills, and four standard tube mills. Bucket elevators handle the product from Griffin mills to tube mills.

From the elevator, the finished product is delivered to cement stock house by screw conveyors. The stock house is built of reinforced concrete divided into four bins, which have a total capacity of 125,000 barrels. The packing room in the stock house is equipped with electrically driven packing machines, which were furnished by H. S. Deck,, Wayne, N. J., and automatic scales. Two switch tracks, each 1,000 ft. long, extend alongside the stock house, giving ample room for cars. The leather belting in this plant was furnished by the Chicago Belting Company.

Krupp grinding machinery was purchased by the city of Los Angeles recently for crushing Tufa, a conglomerate volcanic rock which is found near the site of the city acqueduct cement plant. Thos. Prosser & Son, Chicago and New York are the representatives of the Krupp Co.

THE PLANT OF THE OKLAHOMA PORTLAND CEMENT COMPANY.

The first Portland Cement Plant to be constructed and commence operations in the State of Oklahoma is that of the Oklahoma Portland Cement Company, whose mill is located at Ada.

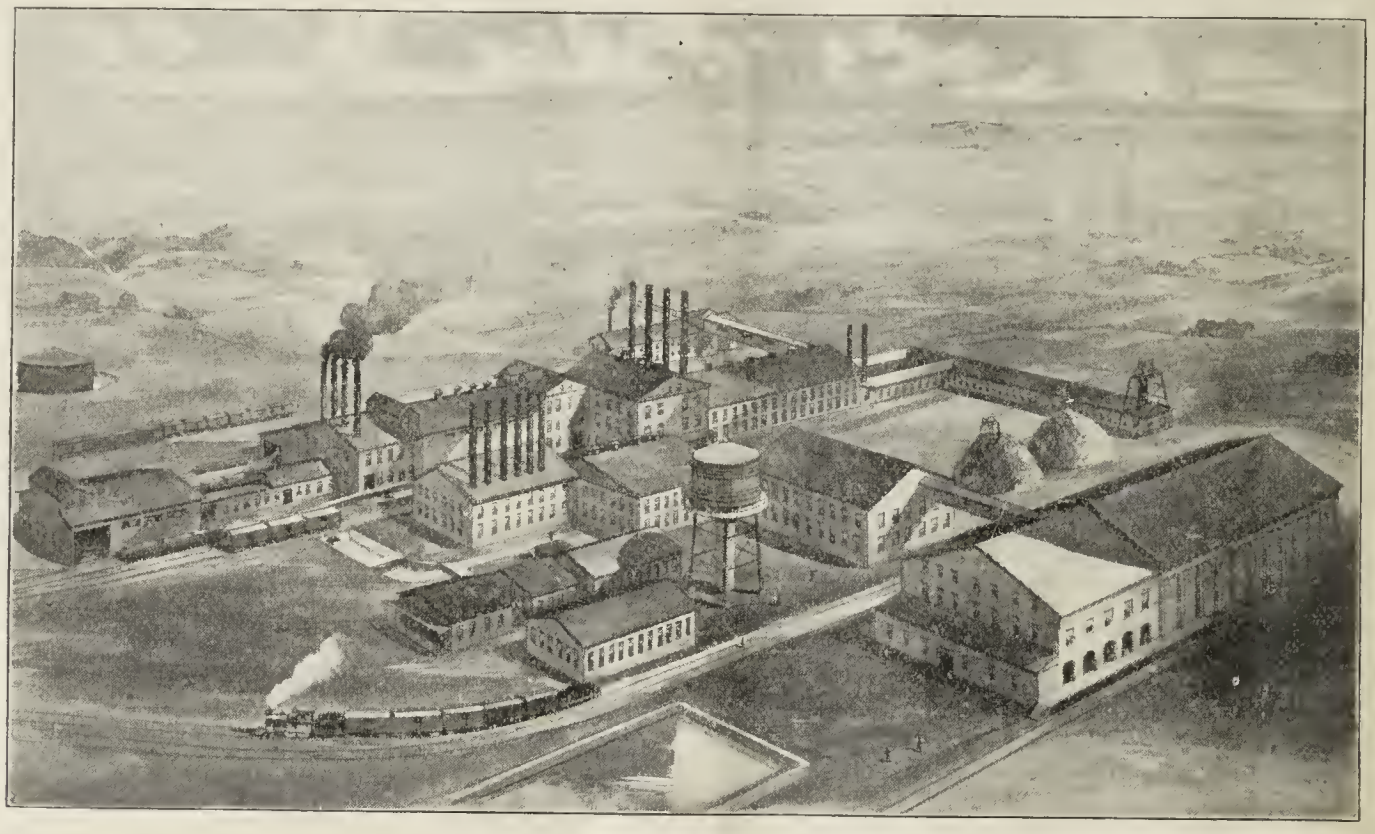
It first commenced operations in January, 1908, and has turned its wheels continuously since that time and produced a material which has met with uniform satisfaction by all of its users.

The mill was designed and built by the men who are now its officers and are operating it. Each man takes a particular pride in the mill, and it is seldom one will find an institution conducted so harmoniously as this one is.

A. L. Beck, president, is well known in the lime industry, and until the organization of this company was the controlling factor in the Mitchell Lime Company, at Mitchell, Ind.

The vice-president of the company is C. C. Bishop, of Chicago.

The secretary is George Keiss, who directs the selling end as well.



The Oklahoma Portland Cement Mill.

The treasurer of the company is J. W. Wintersmith, who is well known in cement circles, as he was for many years connected with the J. B. Speed Company, of Louisville, Ky.

William L. Whitaker is the general manager, and is the man who looks after the mill and manufacturing end. Mr. Whitaker was for many years manager of the Lehigh mill at Mitchell, Ind., and it was he who drew the plans for the Ada mill.

The mill is located about one mile from the town of Ada, and on the line of the Frisco System and Oklahoma Central, as well as a connection with the M. K. & T. Railway. The plant covers about ten acres of property.

The quarry is located about five miles from the plant, and the materials, limestone and shale, are brought to the plant twice a day by the trains.

The mill has a 2,000-barrel capacity, and when it was built arrangements were made to double the capacity, so that an increase can be made without requiring new buildings.

Each department is in a building of its own, though the entire plant is connected. The buildings are of concrete construction on expanded metal lath.

By the arrangements of the machinery the elevating and transporting devices are the most simple and economical that can be planned. Thus the materials are quickly and easily handled from the time they enter the mill as limestone and shale until they come out the finished product, "O. K." Portland cement.

The limestone is dropped from the cars into the McCully No. 6 crusher furnished by Power & Mining Machinery Co. of Cudahy, Wis., and onto a belt to the storage bins. It is then conveyed to the dryers and the moisture removed. The dryers are operated by an individual electric motor and oil is used for fuel. From the dryers the dry material is elevated to the storage, which are bins 120 feet long.

The shale is brought from the quarry and dumped on the ground near the crusher house. An underground belt conveyor carries the shale to the dry pan. The material is shoveled on the belt to have a uniform feed into the dry pan. This is the only place in the plant where the material is handled by anything but mechanical means. The clay is then conveyed to the dry storage. The storage capacity when full will run the plant for two weeks.

The dry materials are then elevated to a hopper and measured by actual weight to their proportions and in batches of 4,500 pounds. The mixed ingredients then drop into a Jeffry Manufacturing Company hammer mill and are conveyed to the Fuller-Lehigh mills, of which there are six of thirty-three-inch size for the raw grinding. From these mills the material is fed into two 125-foot kilns and burned to clinker.

Pulverized coal is used for the burning and the slack coal is put through a dryer, after which it is reduced by two Fuller-Lehigh pulverizers in the coal house, and the pulverized coal conveyed to the kilns.

The clinker is conveyed by bucket elevator to the cooler and comes out a uniform product. A belt conveyor takes the material as it comes from the cooler to the outside for seasoning. A 240-foot underground belt carries the clinker to the finishing department, where it passes through three sets of rolls and is reduced to a smaller size in each set. It is then elevater to the Fuller-Lehigh pulverizers for the finishing.

There are seven mills for this work, three forty-two-inch and four thirty-two inch.

From the grinding department the cement is elevated and carried to the bulk storage house, which is a new building 100x100 feet and just nearing completion. The capacity of this is 60,000 barrels of cement.

Beneath the storage house are four tunnels, through which run Caldwell spiral conveyors. The material will be spouted on the conveyor and carried to the packing department, where it is sacked and loaded on the cars. "No-dust" packers are installed in this plant and are giving excellent satisfaction. They are made by H. S. Deck, Wayne, N. J.

The power plant consists of two Allis-Chalmers corliss engines, with about 1,000-horsepower capacity. The larger one runs the line shaft which furnishes the power to the entire finishing department. The smaller engine runs the generator for the dynamos.

In the boiler house there are four sets of boilers with a combined capacity of 1,400 horsepower. The fuel used here is oil. The water for the plant is pumped by two pumps, which regulate the flow of the water. They now have two sources of supply, so that if one fails the other can be used. The city reservoir furnishes the water, but connection is also made with the river a short distance away. The Chicago Belting Co., furnished the leather belting.

The oil for the fuel is brought in tank cars to the plant and pumped into the storage tank, which has a 7,000 barrel capacity.

The machine shop, where repairs on broken parts of machinery are made, has a lathe and full equipment run by a small electric motor.

The blacksmith shop contains the forges and full stocks.

The company recently had Richard K. Meade, of Nazareth, Pa., make some tests of their product, and in his report he says: "By referring to the physical test it will be seen that the tensile strength of the cement, both tested and with sand, is excellent. The cement is also ground considerably finer than is ordinarily required by specifications. The setting time of the cement is normal. This insures sufficient time being given before the cement hardens for the workmen to properly mix and tamp the mortar, and also trowel off the surface of the work done with it made with both the Pennsylvania and the Pittsburg and Lake Erie Railroads. The rest of the work is to be rushed, and, the officials of the company advise that they expect to place the plant in operation on or about the first of May of this year. The old plant, which is in the immediate vicinity, is being operated, but when the new one is completed the capacity of the company will be increased about 200 per cent.

CAMEO-CEMENT.

With the increase in the use of concrete, both for public buildings and private dwellings, the suitable treatment of exposed surfaces is a problem that has taxed the ingenuity of architects and decorators. The natural gray cement surface is not particularly pleasing to the eye, yet the insetting of tiles or other ornamentation is costly, and seldom artistic in effect.

It has remained for Leon Mazy, a Los Angeles, Cal., decorator of European training, to devise a method, new, practical and inexpensive, by which concrete surfaces may be artistically embellished. This "cameo-cement"— as he calls his invention, for which patents are now pending—has the double advantage of economy in color and durability of material.

Various layers of colored cement are, by this newly-discovered process, automatically combined in the making to form monolithic slabs or tiles, which can be incorporated into the building as it progresses. These tiles may be of any size, and of any color, or a combination of vari-colored patterns upon a background of color.

The "cameo-cement" adapts itself to the translation of any form or pattern, in any tint, and may be treated flat, raised or engraved. Any portion of a design can be individually colored, and the range of colors is complete from the lightest tones to the darkest hues. Being cement, the ornamentation is as durable as the building itself, and as mineral colors only are employed, it may be said to be practically everlasting.

Both the material and color are proof against weather and time. Superficial breaks or chipping by accident

Cameo-Cement, showing how concrete surfaces may be artistically embellished.

are of small detriment, since the color runs through the entire thickness of the pattern.

Cameo-cement may be employed as either an outside decoration or an interior finish; ornaments, columns, chimneys, stair-rails, cartouches and friezes can be made in this plastic material, and in infinite variety of pattern and coloring.

It may be applied in the form of tiles, after a building has been erected, or it may be easily incorporated within the concrete as the work advances.

Mr. Mazy's invention has the advantage over many other methods in the fact that it is not expensive, being, in fact, cheaper than other forms of decoration if the guaranteed permanence of material and color be taken into consideration.

It is pleasant to add that the architects of Los Angeles have become much interested in Mr. Mazy's invention, and that he has already received many orders for panels, among them being several for the front of a handsome home now being built in Santa Monica.

WITH THE CEMENT MILLS.

The Helderberg Cement Company is adding a new stock house to its plant at Howe's Cave, N. Y. The new house will be 220 feet long, 130 feet wide on one end and 75 feet on the other. It will have a storage capacity of 140,000 barrels of cement. The company will have, when this building is completed, a storage capacity of 250,000 barrels of cement.

* * *

George M. Henderson, who has represented the Marquette Cement Manufacturing Company as traveling salesman in Illinois for five years, has accepted the position of assistant sales manager with the Continental Portland Cement Company and will be in charge of the branch office at Little Rock, Ark.

* * *

George L. Huntress has been elected a director of the Aetna Portland Cement Company in succession to the late Robert D. Evans.

* * *

Bonner Springs, Kas.—Two hundred men are out of employment as a result of the shutting down of the Bonner Portland Cement plant. The employes quit of their own accord because, they assert, they had not received any money for their services for two months.

* * *

The Iowa Portland Cement company will announce within a few weeks the date of the opening of its $1,000,000 plant in Southwest Des Moines.

* * *

E. E. Clews, of Youngstown, O., has severed his connection with the Brier Hill Iron & Coal company to assume charge of the Portage Silica company, with offices in the Stambaugh building.

Mr. Clews has had 12 years' experience in nearly all lines of the cement trade, and for a number of years has been the superintendent of that department of the Brier Hill company.

* * *

Glenn Carpenter, who was lately badly injured at the Aetna cement factory, has brought suit for $10,000 against the company. While working in the funnel of the factory his foot was caught in the machinery in some way and it was so badly mashed that Mr. Carpenter claims he will never have the right use of it again. Attorney P. L. Sawyer will appear for Carpenter and the company will represented by the Employers' Liability association of Detroit, in which firm the Aetna Cement company is insured.

* * *

By the latter part of next October the great cement plant of the Piedmont Portland Cement and Lime Company, at Davitte, Polk county, Georgia, will be in full operation, turning out its daily quota of 550 barrels of high grade Portland cement and 300 barrels of lime.

A quarter of a million dollars has already been invested in this plant and property, $95,000 in the most approved type of cement working machinery having been installed within the last six months. Capitalized at $400,000, with every dollar's worth of stock subscribed and some of the best men in the South behind it, located in a region pronounced by experts to be second to none on earth in the quality of raw material the big Atlanta company is expected speedily to assume a commanding position among the cement factors of the Southern states.

At a recent meeting held in the Atlanta offices of the company, in the Austell building, J. C. Bass, of Carrollton, was elected president, while the board of directors elected at the same meeting is composed of men well known in Atlanta and throughout the state for sterling business qualifications and successful careers in the world of finance and commerce.

The revised directorate of the company is now as follows:—

J. C. Bass, Carrollton; C. W. Wood, Carrollton, D. F. New, Carrollton; E. L. Connell, Temple; Walter Sims, Birmingham; W. G. Tyus, Milner; E. S. McDowell, Griffin; A. A. Barge, Newman; E. L. McGee, Rome; E. C. Lester (secretary), Altanta; M. C. Morris, Atlanta; W. E. Jenkins, Atlanta; D. A. Thompson, Covington; A. A. Camp, Winder; H. J. Copeland, McDonough.

* * *

A traveling crane killed Tony Malakans, a cement worker at Buffington works of Universal Portland Cement plant, while he was at work. The machine jerked him thirty feet in the air and hurled him to the cement floor, breaking every bone in his body.

* * *

San Francisco, Calif.—Suit was filed in the United States Circuit Court, the other day by the Osborn Engineering Company against the Henry Cowell Lime and Cement Company to recover $29,126.49, alleged to be the balance due on a contract entered into on June 11, 1906.

By the terms of this contract the engineering company was to have located a site for a plant for the manufacture of cement and superintend the erection and installation of the plant for 3½ per cent of the cost.

This cost proved to be $1,313,489.41, making the percentage claimed by the engineering company $49,972.15, in addition to wages and expenses of a superintendent while the plant was being tested of $155.52.

Of this sum, it is alleged, only $17,001.16 has been paid, leaving a balance of the amount sued for.

CONCRETE IN WATERWORKS CONSTRUCTION.

The advantage of concrete, both plain and reinforced, for the various parts of a waterworks system were pointed out by Mr. William C. Mabee, constructing engineer for the Indianapolis, Ind., Water Company, at the Milwaukee convention of the American Waterworks Association, and the general remarks regarding its applicability, made in the beginning of the paper, were illustrated by descriptions of and cost data regarding the plant at Indianapolis, in which concrete has been used to a large extent.

Concrete, Mr. Mabee stated, has many advantages over other types of construction. It is easily and conveniently handled and transported, often at a less cost than stone masonry, and often suitable sand and gravel for the work in hand can be found on the site. With proper supervision, skilled labor is not essential in the usual work. Concrete has the additional advantage over stone of being readily molded into intricate shapes.

To produce concrete surfaces of a satisfactory smoothness and uniformity it is necessary that the molds be carefully and properly built, and also that the concrete be of the proper consistency to flow readily, and it is also necessary to thoroughly churn and keep it in motion in the molds.

Concrete may be placed in moderately freezing weather if proper precautions are taken to warm the gravel or stone and sand, to heat the water and to cover the work until initial set takes place.

The problem of preventing cracks has worried engineers. It has become the practice to provide for these cracks by building short sections in alternate blocks; however, by the judicious introduction of steel bars,

bjectionable contraction cracks can be entirely elimi-ted.

The water works engineer or superintendent, Mr. labee believes, is particularly interested in the subject f waterproofing concrete. It has been shown that wet oncrete is more dense and consequently more imper-ious than dry concrete, or less porous as the quantity f cement is increased or diminished. A smoothly roweled surface produces a water-tight film or kiln. t has also been found that slaked lime added to the oncrete mixture helps to make it less permeable. The ime does not injure the cement in any way, lthough retarding the setting. Coal tar, pitch nd asphalt mixtures applied on concrete are used with more or less success. A wash composed of 1 b. of lye, 5 lbs. of alum and 2 gal. of water, applied with brush and well rubbed in, has been used successfully n government fortifications. A rich cement mortar plastered over concrete Mr. Mabee believes makes a very good waterproofing medium.

Regarding experiments made on large reinforced concrete pipes by the United States Geological Survey, and intended to discharge under pressures up to 35 lbs. per square inch, Mr. Mabee states that they have demonstrated the permeability of concrete and the practical value of different kinds of plasters, paints and washes. It was found, he states, that all of the tests made on washes or paints gave comparatively poor results.

The conclusion drawn from these experiments was that the best results could be obtained by giving the inside of the pipe one coat of plaster ½ in. thick, composed of one part cement to one and one-half parts sand and a small quantity of lime paste thoroughly cooled to retard setting, keeping the pipe well wet ahead of the plastering, and when this coat, which is left rough, had dried, adding another coat, about ¼ in. thick, of plaster composed of one part cement to one part of sand. This coat should be troweled to a smooth surface and when dry the entire inside surface of the pipe should be covered with a thick wash of cement and water. When the water pressures are not great and the concrete is sufficiently rich in cement, no plastering is necessary.

Concrete has found a wide field of usefulness and it would be difficult to imagine a purification works built today in which concrete was not the principal building material. It is particularly adapted to the constructon of water conduits and pipe lines, to tanks and basins, to water towers and standpipes, to reservoirs and clear wells and to filters, either slow or mechanical. Mr. Mabee then reviewed the progress of the application of concrete to filter construction, leading up to a description of the concrete structures of the works with which he is connected.

The filter plant of the Indianapolis Water Company is supplied by a gravity flow from the Indiana State Central Canal, which was originally built by the state for transportation purposes, and later was purchased by the company. The head gates and concrete sluiceways of the canal are located about 6½ miles above the intake to the filters. The canal is carried over Fall Creek in an open aqueduct at a height of 18 ft. above said creek. On March 26, 1904, a flood carried away the existing aqueduct, which was built of wood, supported by steel trusses on rubble masonry piers and abutments. The bridge was rebuilt as a reinforced concrete structure 300 feet long and 41 feet wide, having four skew segmental arches, each of 60 feet span with a 10-foot rise from the springing line to the soffit, and a crown thickness of 18 inches. The height from the foundation courses to the towpath is 35 feet 9 inches. The foundations for the piers, abutments and wing walls were carried down 16 feet below water and rested upon a bed of sand and gravel.

The arch ring is reinforced with 8-inch steel I-beams spaced 2½ feet on centers and bent to the curvature of the arch. Over the extrados of the main arches and in line with Fall Creek were built small transverse arches, the purpose of which was to increase the discharging capacity of the bridge during freshets and to eliminate the possibility of freezing, which might occur with hollow spandrels.

Over these smaller arches was placed the trunk or aqueduct proper; this was constructed of a 9-inch concrete slab reinforced with steel rods, extending into the side walls, which were 6 feet high and 2½ feet wide, with a projection of 2½ feet supported by concrete brackets, making a walk or towpath 5 feet wide on the downstream side and a series of notches or weirs on the upstream side to relieve the canal of surplus water.

The trunk is 36 feet wide in the clear, with a depth of water in the channel of 5 feet. These side walls were built in short alternate sections and were connected by sheet-lead expansion joints. The lead sheet was about 20 inches wide and 6 feet long; it was folded lengthwise with a convolution in the center of the sheet and holes were punched in the sheet for anchorage in the adjoining sections.

This expedient, Mr. Mabee states, has proved entirely successful. The aqueduct has been in service now for four years and no leaks have developed, although contractions of the sections have been noticed during cold weather.

The structure contains 4,500 cubic yards of concrete mixed 1:2:4, the cost per cubic yard being as follows: Cement, $1.90; steel, 77 cents; sand and gravel, 54 cents; lumber, 90 cents; form labor, $1.12; concrete labor, $1.29; total, $6.52.

The filters built in 1902 are of the slow sand type, covering 4.8 acres; they were originally built open and in three large units. It was found necessary to cover and divide them into six units, approximately 100x350 feet each. Cast-iron columns were selected for the supports in preference to concrete piers, to save time in erection and to minimize the disturbance of the filter material and pure water drainage system, which had been completed and in operation since September, 1904. No provision had been made for covers in the original plans.

The covers consist of 3-inch slabs supported by concrete beams 19 feet 7 inches long spaced 6 feet 9 inches on certers; the beams are 8 inches wide and 15 inches deep; these are in turn carried by 18-inch I-beams encased in concrete and bolted to the columns, forming a continuous girder 22 inches deep, which is supported on cast-iron columns 7 inches in diameter and spaced 20 feet 3 inches on centers. The columns rest on cast-iron base plates 15 inches square, laid on short piers. They are filled with concrete and are kept painted with asphalt paint. The excavations for the columns was accomplished by means of cylindrical sections of steel plate which were easily driven down through the 4 feet of filtering material.

The partition walls are 14 to 17 feet high and 1 foot thick, reinforced in both faces vertically and longitudinally with ¾ and ½-inch bars respectively. The slab reinforcing consists of ¼-inch bars spaced 3 inches on centers in the direction of load and 6 inches on centers in the opposite direction.

The entire slab, covering 70,000 square feet in each double filter, is built monolithic, without any attempt to provide expansion joints.

About the four sides there is a parapet wall for retaining a cinder filling, and for closing the spaces between the beams. This wall is kept separate from the main supporting wall by a paraffine joint, the I-beams resting on rollers in the wall. The lubricated joint was provided to allow the cover to expand and contract freely without introducing bending into the main wall. These covers and walls are water tight for all practical purposes.

The work was done with a cableway, spanning 450 feet, with movable towers, the concrete being handled from the mixer to the cableway by means of a shuttle car on a narrow gauge track, propelled by a stationary engine and cable. In this way 80 cubic yards was an average day's work covering 5,000 square feet of surface. The concrete was mixed in proportions of 1:2:4. The cost of walls and covers are given in accompanying table.

The pure water reservoir is built near Fall Creek on a gravel foundation at the ordinary ground water level. The groined arch bottom was designed to resist the upward thrust of extraordinary high ground water at such times that the reservoir is empty. The earth fill, 2 feet deep on the cover, and the weight of the structure itself would overbalance any upward pressure that might occur.

The lower section of the arch is reinforced with ½-inch twisted bars spaced 10 inches on centers in either direction, to bond the sections together and to prevent contraction cracks. No other water proofing material was used, as under the low head of water carried the amount of percolation through the concrete itself would be inconsiderable if cracks could be prevented.

The walls were 1 foot thick, securely anchored to the floor and cover, and were reinforced against side thrust in both faces and against longitudinal temperature stresses. The wall was built monolithic about the four sides of the reservoir, the corners being rounded by curves. Nothing worse than a few fine hair cracks showed up and these did not occur at the corners as is usually the case.

COST OF WALLS AND COVERS EXCLUSIVE OF SUPERINTENDENCE.

	Cost of Walls Per cu. yd.	Cost of Covers Per cu. yd.	Cost of Covers Per sq. ft.
Reinforcing bars	$3.05	$4.45	$0.076
Labor placing bars	0.76	0.65	0.011
I-beams	...	...	0.063
Placing I-beams	....	...	0.003
Sand and gravel	0.75	0.75	0.013
Cement	1.61	1.85	0.031
Placing concrete	1.00	1.06	0.018
Lumber for forms	0.55	1.06	0.018
Labor on forms	2.98	3.52	0.060
Columns	...	...	0.031
Miscellaneous	1.36	1.31	0.020
	$12.06	$14.65	$0.344

The roof slab is 5 inches thick, reinforced with ⅜-inch rods with variable spaces; this slab is supported by concrete beams 8 inches wide and 16 inches deep, which are carried by plain concrete columns 12 inches square, spaced 10 feet on centers.

The cost of the pure water reservoir per 1,000 gallons of storage was $9.33, exclusive of superintendence and office expenses. The cost per square foot of water surfaces was as follows: Excavation (7-foot cut, $0.08¼; refill on cover (2 feet), $0.03; floor, $0.15¼; wall (distributed), $0.04½; cover, $0.24½.

The greatest amount of concrete placed in one day of 10 hours was 134 cubic yards, while the average amount for the concreting period was 70 cubic yards. The total quantity of concrete was 5,195 cubic yards; the total excavation, 26,000 cubic yards and the total refill 10,000 cubic yards.

The reinforced concrete pipe line was built during the winter of 1907-08. It is 840 feet long and is used for the purpose of conveying raw water to the precipitation basins. It is laid 11 feet below the hydraulic gradient. The inside diameter is 66 inches and the concrete shell is 6 inches thick. It is reinforced with ½-inch twisted bars spaced 8 inches on center in either direction. The pipe was built in three general operations after the ditch had been dug to dimensions corresponding to the outer circumference of the pipe.

A concrete cradle 30 inches wide was first laid to grade holding the lower circumferential rods, the rods being held in position by curb boards notched to receive them and also by the lower longitudinal rods. These lower circular rods were heated and bent in the field to the require dshape, and they were left long enough to project into the upper ring about 12 inches. Semi-circular metal forms were then placed on this cradle and fastened down by timbers laid across the tops and staked into the side of the trench to prevent the forms from floating.

The concrete was mixed in the proportion of one of cement, two of sand and four of gravel, and was poured into the space between the side of the ditch and the metal forms, this operation completing the lower half of the pipe; the metal forms were then inverted and supported on wooden roller bearings and wooden track. The upper rods were then fastened to the lower projecting rods and curved wooden forms were braced into position for molding the upper ring, leaving a space 18 inches wide open along the top for placing the concrete.

To facilitate the setting, as this work was done during the cold weather, gasoline torches were burned inside the completed portion until the whole was completed, and the narrow exposed strip on top was protected by canvas. About 100 feet of completed work a day was the usual progress, the metal forms being moved ahead in 100-foot sections without disjointing Mr. Mabee reports that no cracks of any kind were discernible at the completion of the work, and that the pipe is watertight.

COST PER LINEAL FOOT OF 66-INCH PIPE.

Placing centering and forms	$0.958
Rental of metal centers	0.120
Steel reinforcing bars	1.054
Labor placing bars	0.258
Cement	0.674
Placing concrete	0.843
Hauling materials, including gravel	0.054
Engineering	0.054
Miscellaneous	0.098
	$4.45

The price contained altogether 300 cubic yards of concrete, and the total cost as $12.46 per cubic yard. The cost per lineal foot is given in the table. The concrete was mixed in a batch mixer and wheeled an average distance of 500 feet.

Bids received on 60-inch light steel pipe proposed for this purpose on board cars Indianapolis ran from $6.70

o $7 a foot. One bid contemplated furnishing and lay-ng in the ditch prepared by the company for $8.25 per oot. Sixty inch lightweight cast-iron pipe would have ost $15.50 a foot, f. o. b. Indianapolis, to which nust be added the cost of lead and laying to make the osts comparable.

The cost of the concrete pipe, Mr. Mabee points out, lid not include excavation, which would have been the ame in either case; nor the cost of the gravel, which vould add about 27 cents a foot; so that the reinforced concrete pipe cost about one-half as much as steel and about one-fourth as much as cast-iron; in addition it s 6 inches greater in diameter than either, besides hav-ng the advantage over steel of greater durability.

With the installation of the preliminary treating plant, it became necessary to know how much raw water was being treated with chemical, and at the same time have the apparatus for recording and indicating these amounts convenient to the operating headquarters. Accordingly a reinforced concrete Venturi meter 42 inches in diameter, having a throat diameter of 21 inches, was built in the 42-inch raw water conduit and the indicating apparatus was placed in the laboratory building. The throat section was of cast-iron and brass and was furnished together with the recording apparatus by the Builders Iron Foundry, of Providence, R. I. The conical forms were made up by the planing mill and worked on perfect lines and dimensions. The concrete was mixed in proportions of one of cement, one and one-half of sand and three of gravel. The meter was built in the fall of 1908 and has been in service now for several months and is, Mr. Mabee reports, in every respect satisfactory.

The coagulation basin is part of the general scheme for clarifying the raw river water by coagulation. The baffle walls are 70 feet apart and are reinforced simply to prevent contraction cracks. The embankments are of earth, sloping two on one, and are lined with a 4-inch slab of concrete, reinforced by $\frac{5}{8}$-inch twisted rods spaced 4 feet apart in either direction. The slab floor is 4 inches in thickness and was laid in alternate blocks 8 feet square. The floor slopes 1 in 35 to the open ditches, which in turn slope 0.2 to the 100.

Water pressure pipes with hose connections are built into the baffle walls to facilitate the flushing out of sludge during cleaning periods. This portion of the precipitation basin was built during 1908 and went into service last November.

THE TRUE VALUATION OF PORTLAND CEMENT.

The specifications for Portland cement become more rigid every year. Cement which years ago was considered the standard would today hardly rank among the average. The growing experience of the men behind the wheels, improved machinery, and economical management, enable the present manufacturer to place on the market a cement far superior to that turned out by the old methods and one that will meet all specifications.

No doubt there are a few cements which will barely pass the specifications, and more that will exceed the specifications 10 to 100 per cent, and the manufacturer who is able to put a cement on the market far above all requirements is the one who should receive the most money for his products. In most instances in addition to the price received for the cement, he will, for the merit of his goods, receive a great deal of advertising, especially from the small consumer. It is different with the large consumer, as he is bound by his specifications and contracts to take a certain amount of cement, and as long as it passes the specifications, he will not pay more for a cement exceeding the specifications. He also contracts to use a certain amount of aggregates with the cement, with no regard for the quality of the cement, where if the cement exceeded the specifications he could use more aggregates and less cement and have results equal to concrete made from cement just passing the specifications.

If the cement manufacturer could combine the architect and the supervising engineer to base their specifications on the merits of the Portland cement to be used, they would, no doubt, look for the cement which would take more aggregates and less cement, and although paying more money for the cement would save on work they were doing. Also it would compel the cement manufacturer putting a cement on the market which just passes specifications to pay more attention to quality than quantity, resulting in efforts to get a better grade of cement.

A LARGE REINFORCED CONCRETE SEWER.

The domestic sewage flow and the storm water run-off from a residential section of about 6000 acres in the northern part of St. Louis will be carried to the Mississippi River in a large re-inforced-concrete sewer that has been under construction during the past three years. The area to be served is comparatively rough and broken, and lies from one and two miles back from the river. Between the latter and this area is a stretch of flat bottom land 6 ft. to 12 ft. above maximum flood levels. The outlet end of the first section of the sewer that was built was about 1500 ft. toward the river from the first rise to the higher ground. Since then the sewer has been extended toward the river and also back through the area inland.

As a part of the extension toward the river, a section of the sewer 169 ft. in length was built under the right-of-way of the Chicago, Burlington & Quincy Railroad. This section is of similar design to the balance of the sewer adjacent. It has a semi-circular arch with a flat inverted semi-circular arch bottom, and is built of reinforced concrete. In practically all of the length of the sewer across the low area the intrados of the arch has a radius of 14.5 ft., and the invert intrados a radius of 29 ft. A number of railroad tracks already cross this low area, and as many more doubtless will be laid in the future. The sewer was designed to carry the loads that will be brought on it in this manner. The assumptions made in the design and the details of the latter were discussed in the article printed in the issue of Dec. 14, 1907.

Three classes of concrete were used in the sewer barrel. The arch concrete, designated as Class A, was made in the proportions of one part Portland cement, two parts river sand and five parts gravel: 3-58 cu. yd. of concrete of this mixture were required to the linear foot of sewer. The concrete in the invert and the side walls, designated as Class B, was made of the same materials in the proportions of 1:3:6. In ordinary soil about 4 cu. yd. of this class was required. Where soft bottom was encountered additional concrete made in the proportions of 1:4:8 was placed in the bottom. The proportions of these mixtures were varied to suit the percentage of voids in the sand and gravel. The intrados of the invert was lined with a single course of vitrified paving block to protect the concrete from wear.

The short section under the railroad right-of-way was built under contract by the Hoffman-Hogan Construction Company, of St. Louis. The soil through

which most of the trench for this section had to be made was a sandy loam with some clay mixed in it. The cut had a maximum bottom width of 35 ft. and an average depth of 30 ft. A tight wall of single-thickness wooden sheeting had to be driven on both sides of the trench and shored in place to prevent caving. Comparatively no ground water was encountered during the progress of the work and only a small amount of pumping was required to handle the surface drainage.

The excavation was made by hand, the spoil being loaded into 1-yd. buckets which were lifted out of the trench and delivered to piles at the side by means of a guyed derrick set up at the ground-level. This derrick had a 60-ft. boom and was mounted so it could reach across the trench, thus permitting the spoil to be placed in piles along the opposite side of the latter from it. After the completion of the sewer barrel, teams and scrapers were used chiefly to make the back fill with material taken from these waste piles, although some of the spoil was loaded into the buckets and delivered to place by the derrick.

The line of the sewer is at right angles to the adjacent railroad tracks, which were available for the delivery of the concrete materials. The sand and gravel were dumped from the cars into storage piles along the track and the cement was stored in a shed adjacent to the work. A Smith mixer was set up on a portable platform arranged so it could be shifted along as the concrete work progressed. The sand and gravel were delivered from the storage piles to the mixer in wheelbarrows operating on a runway built up to the charging end of the latter. The mixer discharged directly into 1-yd. buckets, in which the concrete was handled to place in the forms by the derrick.

The contractor used wooden forms with built-up arch rib centers shored in place from the bottom of the completed work. The arch ribs were made so they could be taken down and moved ahead for use again without being dismantled. A sufficient quantity of lumber was obtained to make a length of about 16 ft. of forms.

A very complete record of the amount of labor required on the various features of the work was made by the resident engineer of the municipal sewer department according to the regular detail system of that department that is followed in all similar work. The cost of materials and of the plant employed in the construction also were determined accurately each day so a final determination of the total cost of the work could be obtained.

The cost of 5535 cu. yd. of excavation made was kept under the three following heads: Moving the derrick, shoring the sides of the trench, and excavating, hoisting and hauling. In connection with all three of these divisions of cost of the excavation and in the records of the costs of all other parts of the work, an allowance of 3 per cent on the payrolls was made for employer's liability insurance. In all cases a special attempt likewise was made to secure the entire cost of each feature as nearly as it was possible to segregate the different items. Since local prices of labor vary in different parts of the country, an attempt will be made to give simply the amount of time consumed in handling the work, and in addition the unit costs as figured on the rates of labor prevailing at that time will be stated.

Moving the derrick for the excavation required the time of one foreman for 10 hours, the time of laborers equivalent to one man for 45 hours and a hoisting engineer for 11 hours. The shoring of the excavation required the time of the foreman of 20 hours, 47 hours of first-class labor, 358 hours of second-class labor and 18 hours of the time of the hoisting engineer. It also required 5000 ft., board measure of lumber. The excavating, hoisting and hauling of the material taken out of the trench involved the time of men as follows: A head foreman for 1157 hours, a gang foreman for 55 hours, a hoisting engineer for 1105 hours, tag-line man on the derrick, for 363 hours, team drivers for 1422 hours, first-class laborers for 1285 hours, second-class laborers for 8496 hours, third-class laborers 90 hours, bottom men 68 hours, water boy, 196 hours, and a timekeeper for 482 hours. In addition, teams, slips and plows were employed on the basis of 549 hours for a single outfit. The hoisting engine and derrick was employed 1024 hours, for which an average cost of 8 cents an hour was charged. This rate is based on the difference between the cost of the plant at the start of the work and its value at the completion of the contract. In connection with this part of the work 632 bushels of coal were burned and 24 gal. of oil were required on the machines. At the current labor prices the total cost per cubic yard of the excavation was $0.8386.

The cost of the materials for the vitrified-brick masonry was as follows: 27,000 brick at $10. 8.81 cu. yd. of sand at 75 cents, and 124 sacks of cement at 32 cents, or a total of $316.29, making the cost per cubic yard $4.64. The time of the forces employed in laying this masonry was as follows: The bricklayer, eight hours; mortar-man, four hours; hod carriers, four hours, bricklayer's helper, nine hours, and general labor, 219 hours. The transportation and hauling in connection with the brick masonry required a hoisting engineer for five hours, a foreman for four hours, a tag-line man on the derrick for three hours, and 22 hours of common labor. The time of the engine and derrick was charged to the work for three hours at 8 cents; 2.3 bushels of coal and 0.012 gal. of oil were also estimated to have been used in this connection. Summing up these items at the local labor rates, the total cost per cubic yard of the brick-masonry lining of the invert was $5.655.

The 608 cu. yd. of Class A concrete used required 540 cu. yd. of gravel, 225 cu. yd of sand 3512 sacks of cement. Class B concrete to the amount of 448 cu. yd. was used and required 379 cu. yd. of gravel, 197 cu. yd. of sand and 2072 sacks of cement. Only 74 cu. yd. of the Class C concrete were necessary, as the bottom was fairly good.

The forms for the arch and sidewalks required 22,809 ft., board measure, of lumber and $10 worth of nails and bolts. The labor account chargeable to the construction and repair of the forms amounted to eight hours of the foreman's time, 216 hours of carpenter's time, 42 hours of helpers' for the carpenters, and 120 hours of common labor. At the local rates for labor, and with lumber at $25 a thousand, the average cost of the construction and repair of the forms was $0.643 per cubic yard of concrete. Moving the forms required 42 hours of the time of the carpenter's helper and 157 hours of common labor. On the same basis the average cost per cubic yard of concrete for moving the forms was $0.042.

In placing the concrete the time of the foreman was required for 13 hours, the laborers' time in the actual work of placing, 416 hours, and in tamping, 212 hours, with an addition of about 20 hours for general help. On this basis the cost per cubic yard of placing the concrete was 13.5 cents.

The total amount of time involved in mixing the 1130 cu. yd. of concrete used was as follows: 129 hours for the foreman, 535 hours of common labor in general work, 202 hours of labor wheeling sand, 564 hours of labor wheeling gravel, 170 hours of labor wheeling cement, 10 hours of labor in dumping the mixer, 47 hours for the hoisting engineer and 6 hours for the tag-line man on the derrick. The depreciation of the mixer was charged to the work as 118 hours of time at 4 cents an hour.

The mixer required 113 kw-hours of electric power to operate it. Twenty-five hours of time of the hoisting engine was charged to the wor kof mixing at 8 cents an hour. Eighteen and six-tenths bushels of coal and 1 gal. of oil were required in the mixer plant. From this record the cost of mixing concrete was $0.374 per cubic yard.

The transportation, hoisting and hauling of the concrete and the materials for the latter involved the following amount of labor: The foreman for 19 hours, the hoisting engineer for 93 hours, a signal man for 5 hours, 260 hours of labor unloading gravel, 118 hours of labor unloading cement, 21 hours of labor wheeling cement, 117 hours of labor unloading sand, 85 hours of common labor, 85 hours of labor for general work, 34 hours of the time of a driver and a team and wagon for 44 hours. Adding the time of the engine, derrick and hoist to this work at the rates given before, and allowing for the amount of coal and oil consumed, the cost per cubic yard of concrete for handling materials for it was $0.211.

On this detailed basis of accurate records, the Class A concrete cost $4.135 per cubic yard. The cost of the Class B and Class C concrete differed from this only in the amount of cement used.

The reinforced steel required 10 315 linear ft. of 1-in. bars, 29,653 linear ft. of ⅞-in. bars, and 10,741 linear ft. of ½-in. bars. The carrying, placing and wiring of this steel cost an average of $0.0037. The transportation and hauling cost $0.00048 per linear ft.

It was necessary to bend 9760 ft. of the ⅞-in. bars and 3465 ft. of the ½-in. bars. On the basis of the total length of these bars bent, the cost of bending was $0.007 per linear foot. On the basis of the material actually bent, the cost per linear foot averaged $0.0024.

In addition to the time chargeable to the different features of the work, a total of $561.54 for labor, tools, and incidentals was recorded that could not readily be distributed.

Mr. H. R. Fardwell is sewer commissioner, and Mr. J. A. Hooke is assistant sewer commissioner of St. Louis. The work was handled under the direction of Mr. R. M. Bristol, engineer of construction of the sewer department of St. Louis, and Mr. P. A. Richardson, assistant engineer.

BONDING NEW TO OLD CONCRETE.

For connections made after a lapse of 24 hours or more, break back the surface concrete to firm material, and clean the fresh surface with steam, air blast or forceful water streams so as to remove all fine loose material. Saturate well, but not so that water stands on the surface or oozes from the material. Paint completely with neat cement grout, mixed to the consistency of thin cream, just before new concrete is deposited, and see that the latter is of proper mixture, containing a proper proportion of mortar, which should be worked against the joint so as to be certain that no voids exist in its vicinity.

For connections made after long intervals, so that the old cement has set hard, and where the expense of roughpointing the whole surface is greater than is required because of the nature of the desired bond, use commercial muriatic acid, diluted with clear water, 1 to 5, or the commercial bonding powders, dissolved in clear water at the rate of 5 lbs. of powder to 10 gals. of water. First wet the old concrete surface with so much water that a fresh wetting is not immediately absorbed. Remove any excess of moisture and, when the surface appears as if commencing to dry, paint on the old surface three successive coats of acid one after the other. Let this remain for about 30 mins., after which carefully clean the surface of unspent acid, soluble salts, and fine material, with plenty of water, finally cleaning with a steam jet or air blast if obtainable. Just before the fresh concrete is to be deposited, and while the old material is still very damp, apply a thin coat of neat cement grout mixed to the consistency of thin cream, just before the new concrete is deposited, and see that the latter is of proper mixture containing a proper proportion of mortar, which should be worked against the joint so as to be certain no voids exist in its vicinity.

Generally, if proper bonding methods are adopted, with acid and grout, work may be stopped along 45° planes at any point in a beam, at pleasure, between the ends and the third points; such planes would better be diagonal compression planes. The writer prefers such joints to vertical ones at the centers of beams, where direct tensile and compressive stresses are larger. Further, it is to be remarked that nothing but ample reinforcement, consisting of stirrups or numerous diagonal rods, can compensate for the detrimental effect of a horizontal joint left along or near the central axis of a beam. The writer prefers numerous stirrups, well connected to the tension rods, and amply anchored in the top concrete.

BIDS ON GALVESTON CAUSEWAY.

A number of bids were recently submitted at Galveston, Texas, for the construction of the proposed causeway across Galveston Bay to connect the mainland with Galveston Island. The contract for building the concrete arch and roadway was awarded to A. M. Blodgett Construction Company of Kansas City, Kans., at $1,232,000. The Pennsylvania Bridge Company of Beaver Falls, Pa., secured the contract for constructing the lift bridge, which is to be a part of the causeway, at $94,400. The entire structure must be finished by December 1, 1911. Only a portion of the bids were on the structure complete.

BUILDING CONCRETE OVENS.

The American Foundry Company has under construction at its plant in Indianapolis, two reinforced concrete drying oven, the first attempt to use concrete for such construction that has been made in the United States. The ovens are being constructed after plans drawn by George W. Bunting and include two ovens of concrete, one of which is to be inclosed in a concrete building. Lynn B. Millikan is in charge of the construction.

Heretofore drying ovens for cores and other products of the foundry have been built entirely of brick. The ovens will have fireboxes in the pits and will be equipped with a peculiar system of heating.

COAL CONSUMPTION IN ROTARY KILNS PER BARREL OF CEMENT.

Investigations have been made in Germany, and are now being carried on, as to just what amount of coal is consumed by a rotary in the manufacture of a barrel of cement, and the average result based upon experiments with a rotary kiln 65½ feet at the discharge end and 7 feet at the receiving end, is that it requires really 110 pounds of coal dust to burn 232 barrels of cement. In this connection, the question of percentage of waste gases and the utilization of the same was thoroughly gone into, and will be the subject of further and deeper investigation. In Germany economy is closely studied, and the natural conditions—cheap labor and dear fuel—

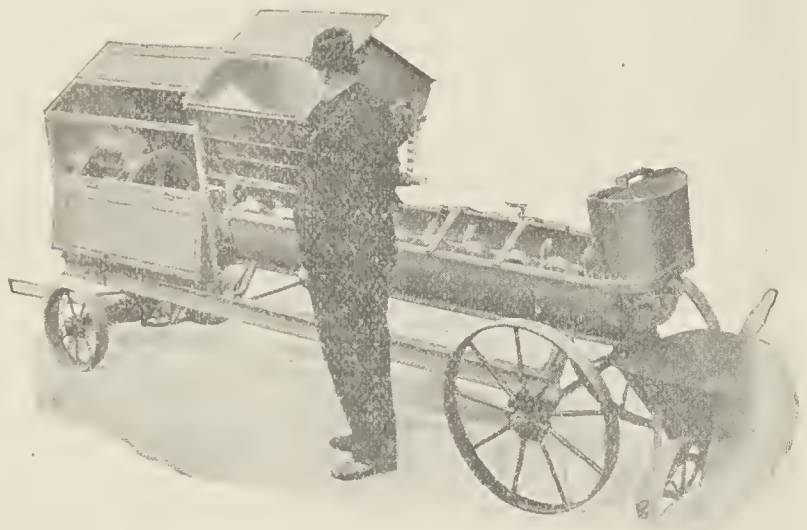
favor the use of the vertical kilns, but the result of the experiments points conclusively to the ultimate adoption of the rotary kiln for cement manufacturing by the Germans.

MIRACLE IMPROVED CONTINUOUS MIXER.

Below is a cut of a new concrete mixer which is designed to mix concrete in any proportions and is a continuous and positive feed. It is used quite extensively in the manufacture of sidewalks and foundations, the making of concrete brick and tile, in fact any class of work where concrete is used.

It is built of iron and steel of the best quality and good workmanship.

The feeding of the materials is accomplished by the screw system, one in each hopper. Three hoppers are used, one for the cement, one for sand, and one for rock, all working independently of one another, and each screw working at a different speed, thus dumping the material in the mixing trough in the proportions desired. By our system of chain sprockets any of the feeds can be changed quickly and at a moment's notice. In addition to this there is in the cement and sand hoppers a slide working at an angle of 45 degrees, and easily operated by hand wheels, for enlarging the opening in the hopper which will increase or decrease the amount of material



Miracle Continuous Mixer.

flowing into the mixer trough instantly. This method is employed more especially to regulate the flow of sand at different stage of moisture, as the flow of wet sand varies from that of dry.

We found by this method, it is possible to get a perfect mixture under most difficult conditions. The sand and cement are dumped into the mixing trough from the hoppers through the same opening and are thoroughly dry mixed by our system of ribbon spiral screws. These two screws are 7′ long and 9″ in diameter, intersecting one another and running in a trough 17″ wide, throwing the material back and forth through the spiral and over again. This mixing is continued dry while the material is travelling about 30″ through the mixing spirals. Then water is applied. This is accomplished by a pipe with holes bored in for making a spray of any desired quantity. Water may be fed from a tank or any convenient water supply. As soon as the water is applied, the rock feed is started. The rock flows into the sand and cement continuously, and is accomplished by a screw feed, the same as is used in feeding the cement and sand, except running at a faster speed than the others. The rock hopper is strongly built and the screw is made of cast steel and is of such shape as to work, without friction or jar and is designed to feed rock up to 3″ in size. The mixing continues after the rock feed is started, down through the mixing trough to the wheelbarrow or any other receptacle in a continuous flow of well mixed concrete. There is a retainer made of steel on the end of the trough to retain the material long enough to change the wheelbarrow.

This mixer is manufactured by the Miracle Pressed Stone Co. of Minneapolis, who will be pleased to quote prices and give any further information.

NEW ORDERS FOR MEDUSA.

The Sandusky Portland Cement Co. of Sandusky, O., have supplied their Waterproof Compound for the following important work:

Harwood Elec. Power Plant, Harwood, Pa.
Van Heynigen Residence, Mobile, Ala.
Napa State Hospital, Napa, Cal.
State Normal School, San Jose, Cal.
Point Bldg., Cleveland, O.

Their Medusa White Portland Cement has also been used on the following work:

University Bldg., Evanston, Ill.
First National Bank Bldg., San Francisco, Cal.
Whitney Bldg., San Francisco, Cal.
High School, Everett, Wash.

Specified by the following Architects in England: James Hartley, and Runton & Barry.

For imitation Terra cotta trimmings on Tremo Hotel, Spokane, Wash.

For exterior cement finish, Dormitory for Pomona College, Claremont, Cal.

Omaha, Neb.—A reinforced concrete mill, to cost over $100,000, will be built by the Peters Mill Company, to replace the one destroyed by fire a few weeks ago. The contract has been let to the Leonard Construction Company, and it is the expectation to have the new mill under roof within 8 weeks.

Cramp & Company, Philadelphia, Pa., have a contract from Ballinger & Perrott, architects and engineers, for an eight-story factory of reinforced concrete, 80′x 14′, at the southeast corner of Thirteenth and Calowhill Streets, for the Goodman-Loeb Company, Contract price, $200,000.

Lightman, McDonald & Company, contractors, Nashville, Tenn., have completed the foundations and elevator pits for the new addition to Cummins Station, and will begin work next week on the superstructure. This is the largest reinforced concrete building job that has been let in Nashville since the building of the original Cummins Station.

The Broadway bridge at Nashville, Tenn., across the Cumberland River, has been completed and is a thing of beauty and utility. The bridge was designed by Howard M. Jones, and was constructed by Foster-Creighton-Gould Company, of Nashville. In design it is strong, metrical and artistic. It was opened with a formal programme several days ago after having been in process of construction for eighteen months. The cost of the bridge was $567,000. The length of the bridge and approaches is 3,250 feet. The concrete trusses are thought to be the highest of that character of any in the country.

F. C. Roberts, County Engineer of Preble County, Ohio, is preparing plans and specifications for five concrete bridges to be erected in various parts of the county, to be let by the County Commissioner of the county.

NEW CEMENT PLANTS TO BE BUILT.

The Osborn Engineering Co., Cleveland, O., has closed the contract for constructing a large cement plant at Arkansas City, Kans., and will start at once on the preparation of plans. The new plant will cost about $500,000. The contracts for the construction work will be let sometime this fall.

* * *

R. T. McWilliams, president of the National Portland Cement Co., Ltd., at Durnham, Ont., will build the plant of the National Portland Cement Co., of California.

* * *

The West Coast Portland Cement Co., Snake river in Idaho will float $600,000 worth of bonds to construct a 1000-bbl. mill. J. M. Edwards, Spokane, Wash., is secretary of the company.

* * *

Ragland, Ala.—The Atlantic and Gulf Portland Cement company is pushing the work rapidly and the big stockhouse is about completed, as well as the machine shops. The two 1000-horsepower engines are being put on their beds, and the large rock drier has been put in place with an 80-foot stack. The company is expecting any day their four kilns, 125 feet long and 7½ feet in diameter, also six 500-horsepower boilers. They have a large crew on the mountain at the mouth of Trout creek stripping the mountain at the lime quarry.

* * *

The Sterling Portland Cement Company, Louisiana, Mo., is marketing 20-year 6 per cent gold bonds for the purpose of building its plant.

* * *

A special from Brigham City, Utah, says: Arrangements have been made by Messrs. Baker, Bell & Day, of the Oregon Portland Cement Company, whereby 170 electric horsepower will be transferred from the Utah smelters at the Hot Springs to the cement factory north of this city. The smelting company will retain 30-horsepower for use at the Hot Springs. The cement company is installing an electric power plant in the canyon east of the factory, and 150-horsepower will be generated at this place to be used at the cement plant, along with the 170-horsepower from this city.

* * *

Harold Day, vice president of the company which is erecting a large Portland cement plant near Brigham City, Utah, and C. La Rue, engineer in charge of construction, drove to Salt Lake in an automobile recently. They were the guests of Mr. and Mrs. Tom D. Pitt while in Salt Lake. Mr. Day's father, is treasurer of the Marshall Field company in Chicago.

Construction work on the cement plant is progressing at a rapid pace, forty men being at work.

The promoters of the project claim they will be producing cement by the first of November. Fowler and Christiansen, contractors, are now putting in the heavy cement foundations and a large force of men are working rapidly on the construction of the plant proper.

The main plant will be a huge structure, 510 feet long and 73 feet in width. Aside from the main building there will be erected a large boarding house, machine shops and other structures needed in the enterprise. The cost of the buildings and machinery to be erected this year reaches $300,000, and next year it is contemplated by the company to erect another plant that will cost nearly that much money.

The plant being installed at this time is considered a unit which has a producing capacity of 500 barrels of cement per day. The output is contracted for by an Oregon company for a period of five years. The idea is, however, to build a unit each year until a plant sufficiently large enough to make all the cement required by the market is obtained.

* * *

As indication of the declining price for money the Marquette Cement Manufacturing Company, of LaSalle, Ill., have accepted an underwriter's offer of par for an issue of 5 per cent first mortgage bonds.

The fund will be used for extension of present plant as the demand for their product is beyond their present capacity.

The value of this company's property is something over two million dollars.

* * *

Hartshorn, Okla.—Oklahoma City Portland Cement Company (lately reported incorporated with capital stock of $1,200,000, etc.) has acquired 200 acres of land as site; will erect steel and concrete buildings; will drive machinery by electricity; steam turbines to generate power; No. 8 crusher at quarry, and will crush rock for commercial purposes; ball tube mill and two big tube mills will be used, and probably Griffin mills on finish end; kilns 8 by 110 feet, equipped with Wicks vertical boilers; plant designed for daily output of 2,400 barrels Portland cement, but only 1,200 barrel unit for installation now; contract awarded to Freeborn Engineering and Construction Company, Kansas City, Mo.; C. B. Blake, Oklahoma City, is president Oklahoma City Portland Cement Company.

* * *

D. D. Dittia, Secunderabad, India, says he has there the materials for making cement. "It is my hobby to manufacture Portland cement on a small scale. The ingredients I have are lime, silica, oxide of iron, magnesia, alumina and gypsum, but I do not much understand these. The gypsum is of such a hard nature that I could not burn it in a furnace."

* * *

Quincy, Mich.—A force of 50 men has been put at work by the Wolverine Cement company, making big improvements at the plant here, already one of the largest in the state. The capacity will be doubled and the establishment will be reopened in the spring. It has been idle for the past year on account of the demoralization of the cement market.

* * *

The Sydney Cement Co., Sydney, N. S., are at present making negotiations with the City of Sydney, as to a bonus of $10,000, granted some time ago by that city to this company. The entire amount will be devoted to the new plant to be built which will be devoted to the manufacture of slag brick.

* * *

New York, N. Y.—The Tidewater Portland Cement Company 115 Broadway, has awarded the contract for the erection of their plant to be built at Union Bridge, Md., to the Fuller Engineering Company, of Allentown, Pa. The plans call for a mill which will produce 800,000 barrels of Portland cement of ordinary color and 200,000 barrels of white Portland cement. The Tidewater Portland Cement Company has a capital stock of $4,000,000 and a bond issue of $1,750,000. The company's consulting engineer is Richard K. Meade, of Nazareth, Pa., and its consulting geologist is Wm. Bullock Clark, of the Johns Hopkins University, Baltimore. The other officers include: President, John K. Tener, member of Congress and president of the First National Bank of Charleroi, Pa.; vice-president, Joseph T. Fanning, president of the Republic Finance Company, 115 Broadway, New York, which is financing the enterprise; secretary, Owen B. Murphy, of New York. It is understood that the company also plans to erect kilns for burning lime

and a plant with an annual capacity of 200,000 barrels of hydrated lime.

* * *

After being idle for some time, the cement plant at Wiarton, Ont., has started operations, and prospects are bright for a period of activity in that section. From 25 to 50 men have been at work overhauling the plant and enlarging the capacity of the store-room. The principal alteration to the machinery is that of re-arranging the four rotaries. This will take between three and four months and it is likely two more will be added. Other changes are contemplated. When the alterations are completed the plant will have a capacity of 120 barrels a day. Next year the intention is to erect a reinforced cement store-house nearer the dock. It is said that there is ample capital at the command of the Crown Portland Cement Co., as the new plant is to be known. The officers of the new company are: President—Charles A. Buhrer. Vice-president, Edgar Stanton; Secretary-treasurer, George W. Videan; Directors: Charles A. Buhrer, Detroit, Mich.; Edgar Stanton, Littlewood, Ont.; Geo. W. Videan, Detroit, Mich.; Wm. Brader, Chatham, Ont.; Wm. W. Whittier, Detroit, Mich.; E. R. Root, Coldwater, Mich.; D. C. Griffin, Ypsilanti, Mich.

* * *

Seymour, Ind.—The Lehigh Portland Cement Company is making some extensive improvements in their plant at Shale Hill, about eight miles southwest of this city, near Shields. Work will begin at once on a new addition to the mill, and a new stone crusher will be put in. A new dryer and boiler are being put in.

* * *

The Maryland Portland Cement Co., Equitable Bldg., Baltimore, Md., are planning to erect additional buildings and machinery to their present plant at Security, Md.

* * *

Warren Portland Cement Co., No. 15 Exchange place, Jersey City, Mfg., Portland cement, artificial stone, building blocks, etc.; capital, $1,500,000. Incorporators; I. R. Coles, John W. Melock and Mortimer L. Sweeney, all as above.

* * *

Louisiana, Mo.—H. G. R. Schwarzk, vice president of the Sterling Portland Cement Co., was here the other day looking after the company's interests north of this city. Chicago office of the company is in Fisher Bldg., capitalized in New Jersey at $1,800,000.

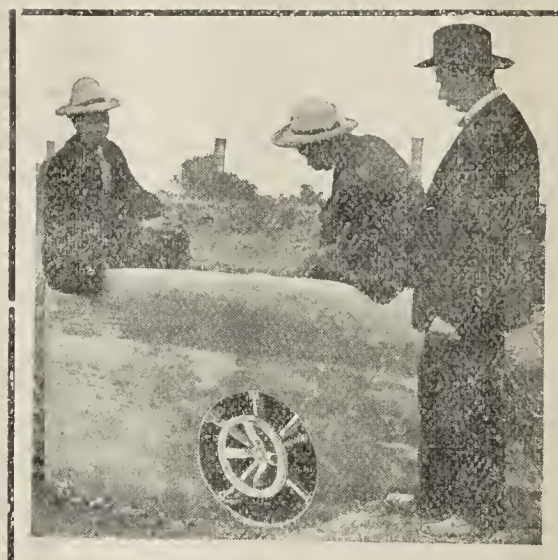
* * *

B. T. Chellquist, president of the Kibbey Gypsum company of Great Falls, Mont., proposes to build a plant to manufacture gypsum products and was in Helena the other day to interest local men in the project.

REINFORCED CONCRETE HOTEL.

Bids are being received at the office of the Great Falls Water Power & Townsite Company, Great Falls, for the construction of a five-story reinforced concrete hotel building to be erected at Great Falls, Montana, according to plans and specifications by Kent & Shanley, architects, Great Falls, Montana.

Each bid must be accompanied by a certified check of $5,000.00 as evidence of good faith, and the contractor to whom the award is made will be required to furnish a Surety Company's bond in the sum of $50,000.00.



MIRACLE
COLLAPSIBLE STEEL FORMS

For Culvert, Conduit and Continuous Sewer Work.

12 to 60 inches in diameter.

6 to 10 feet lengths.

WHAT OTHERS SAY OF MIRACLE STEEL FORMS:

JOE ASHER, Judge of the County and Probate Courts, Pulaski County
LITTLE ROCK, ARK, July 30, 1909.

Miracle Pressed Stone Co., Minneapolis, Minn. GENTLEMEN: I would thank you to forward me the following Collapsible Culvert Forms for the use of Pulaski County, to-wit:

2 pieces 2 feet in diameter 10 feet long
2 " 3 " " 10 "
2 " 4 " " 10 "

Kindly ship the same via St. Louis Iron Mountain & Southern R. R. Co. as soon as possible, and send your account to me for the payment of same.

Yours very truly. JOE ASHER.
County and Probate Judge.

WALTER F. BROOKS, Civil Engineer, County Surveyor of Blue Earth Co
MANKATO, MINN., July 20, 1909.

Miracle Pressed Stone Co., Minneapolis, Minn, DEAR SIRS: Our County Board was so pleased with the 36 inch collapsible culvert forms recently purchased from you that they have instructed me to place an ordor with you for shipment at once, for two 10-foot lengths of the 24-inch collapsible culvert forms; these to be shipped to Mankato. Yours truly,

WALTER F. BROOKS,
Supt. of Construction.

WARRENSBURG, MO., June 19, 1909.

Miracle Pressed Stone Co., Minneapolis, Minn. DEAR SIRS: We are using the 3 and 4 feet Steel Collapsible Culvert Forms that we bought from you, for building the 100 concrete culverts for Johnson Co., Mo. I am seeing after the work and we have finished 21 at this date. We are pleased with your forms and think them a saving of more than 25c over the wooden forms. We are in a position to know as we built 62 culverts on wood forms last year.

I thank you for the prompt shipment of the web I ordered, also for furnishing it without cost. Very Respectfully,
DAVID MOHLER

OMAHA, NEB., June 7th, 1909.

Miracle Pressed Stone Co., Minneapolis, Minn. GENTLEMEN: We have just completed a concrete stone culvert, using your 4 foot collapsible form, and your representative, Mr. Cook, supervised the work.

The culvert is 85 feet in length, and having just completed an estimate of the cost, find it to be one dollar and ninety-five cents per foot. We are pleased with the culvert. Yours truly,
OSCAR J. PICKARD, Chairman of Road and Bridge Committee.

Miracle Pressed Stone Co.
35 Wilder Street, Minneapolis, Minn.

FOR SALE
LOCATION FOR CEMENT PLANT

EXTENSIVE DEPOSITS OF HIGH GRADE RAW MATERIAL. IN THE HEART OF SPLENDID MARKET AND GOOD PRICES. GOOD TRANSPORTATION. NO COMPETITION.

Materials consist of Limestone, Shale and Clay, all of which can be handled by gravity into the plant at a very low cost. Plant site ideal. Splendid climate. All of the materials have been thoroughly tested, and found to equal the best European or American Cements. Will sell control or all. Correspondence from interested parties invited. Address

J. MELVIN, 903 Carlisle Avenue, Spokane, Wash.

CEMENT
.....AND.....
ENGINEERING NEWS

Rear View of J. E. Dalzell's Double Residence,
Being Built of Pauly Concrete Hollow Tile.
Miller & Ford, Architects, Youngstown, O.

See Page 346.

CEMENT AND ENGINEERING NEWS

[PUBLISHED MONTHLY]

WILLIAM SEAFERT, Editor and Publisher

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JOHN F. WALDRON - - - - Advertising Manager

CHICAGO, OCTOBER, 1909.

THE CAUSE OF HAIR CRACKS AND CHECK-CHECKING.

The old theory that hair cracks and checking of finished cement work, can only be prevented by keeping the work continually moist is not absolutely true. Hair cracks and checking are more liable to occur by keeping the surface moist during and immediately after the initial set has taken place. If the cement work is trowelled before the water disappears from the surface of the work, hair cracks, and checking are liable to take place. When the water disappears from the surface, it is absorbed, and enters into the interior of the individual grains. If more water is added after the surface has been drained of its surplus moisture, the additional water, simply assists to dissolve the cement granules on the surface, and causes them to swell and expand, producing a jell, (technically known as gel). This gel is capable of swelling from 20 to 25 times the size or bulk of the original dry cement granules provided there is room or space in which this swelling can take place. There must always be room for a slight swelling on any unconfined surface, for instance, a cement sidewalk surface. This swollen condition is not permanent. The gel shrinks after the surface water has evaporated, and often produces hair and shrinking cracks. The setting and hardening of Portland cement mortar, roughly stated, takes place in the following order. After the cement is guaged with water, the surface of the cement granules begin to dissolve, knitting and binding the individual grains together at contact points, also any sand and gravel, the mass may contain. The entire mass becomes glued together by this cement gel. The cement granules being porous, the surplus water in the gel after a time is absorbed or penetrates into the interior of the cement granule to a certain extent. The water being abstracted from the gel surrounding these granules. As the water is absorbed the surface of the work becomes dull; this is the time when the initial set commences, and the exact time when the trowel finish should be made. The trowelling compresses and smooths off the surface without drawing the neat cement to the surface, as would be the case if trowelled before the surface of the work had become dull, or before the surplus water had been absorbed. The work must be protected from rapid drying or change of temperature. The addition of water at any stage before the final set has taken place is likely to produce defects on the finished work.

Dr. W. Michaelis, Sr., of Berlin, Germany has fully described the process of producing Portland cement gel, and its application in the arts, and especially in the manufacture of cement shingles, in several booklets, which are advertised in our columns, and from which much of the data of this article has been abstracted.

CONCRETE HOUSES.

At Montclair, N. J., there is now in course of construction the long heralded cement house, a building in the construction of which not a piece of wood will be used, nothing but concrete and steel—walls, floors, roofs, outside trim, stairs, partitions, etc. This house will be unique from the fact that it will be the only instance known where the solid, strictly all concrete house has ever been built for practical residential purposes, and will stand for one thousand years or longer.

The site where ground was broken last week is at the corner of Valley road and Appleton place. The firm owning the land and erecting the building is the American Building Corporation, of New York, of which F. D. Lambie, of Montclair, is president and manager, Mr. Lambie has associated with him F. L. Ellingood, architect, who is engaged in building the Pennsylvania Railroad station, and several capitalists well known in the financial world.

The men connected with this movement are engaged in architecture, building and real estate in New York and New Jersey. Their plans do not call for cheap houses, but rather for such as are usually owned by well to do business men; yet, it is believed a better building can be erected at less cost than those now built of wood and surely more lasting.

The house now in process of erection is being duplicated in a suburb of Chicago and in London, England.

Nashville, Tenn., work will soon begin upon a 100 foot span concrete arch bridge over Mill Creek, four miles from the city on the Murfreesboro road. The new bridge will be, when completed, the longest concrete arch in this section of the country, and will be the kind of bridge that is destined to last for ages. It will cost about $10,000.

DEATH OF MR. A. V. YOUNG.

With regret we announce the death of Mr. A. V. Young, who for years represented the Bradley Pulverizer Company, manufacturers of the Griffin mill, in Germany. Mr. Young was spending his vacation in this country. He contracted a severe cold, developing into pneumonia, which caused his death on Sunday, September 12, 1909. In Mr. Young, the Bradley Pulverizer Company loses one of its ablest representatives. It was chiefly due to the diplomacy and tactful manner of Mr. Young that the Griffin mill was introduced into the German market. His numerous friends at home and abroad will receive this sad news with the deepest regret.

THE IOWA CEMENT CONVENTION.

At a recent meeting of the executive committee, it was decided to hold the 1910 convention of the Iowa Association of Cement Users in Cedar Rapids, Iowa, March 9, 10, and 11. Both the meetings and the exhibits, which promise to be more elaborate than ever this year, will be held in the Auditorium.

The Montrose Hotel, one of the best in the state, will be convention headquarters. Cedar Rapids is well located with reference to railroads, and all things considered, will be a highly satisfactory place for this winter's meeting.

Further details will be announced later.

THE NORTHWESTERN SHOW.

The Sixth Annual Convention and Cement Show of the Northwestern Cement Products Association will be housed in one of the most magnificent Auditoriums in the world. The Commercial Clubs of the City of St. Paul donated its use to the Association. This assures that the coming convention will have unlimited space for exhibits. The Auditorium is the largest building of its kind in America. It is exceptionally adapted for a Cement Show. Teams loaded with cement machinery can drive through its immense doors direct on to the exhibition floor. The main hall is on a level with the street. The building is a block long, flanked on two sides by wide beautiful corridors with numerous doors leading therefrom direct to the exhibition floor. The Auditorium was erected by the citizens of St. Paul for the benefit and pleasure of its people, and as a palace wherein to welcome guests of the city. The building itself will be a revelation to visitors to the Cement Show. The building cost $460,000 and is absolutely fire-proof, constructed principally of concrete-brick and steel, and contains nothing inflamable, except a limited amount of wood interior finish, seats, stage property and settings. Compared with other great buildings of America the main dimensions of the building are: St. Paul Auditorium, 311x198; Madison Square Garden, 310x194; New York Hippodrome, 200x225.

The seating capacity of the Madison Square Garden is 7800, the Hippodrome 4000, and the St. Paul Auditorium 10,500. One thousand representative men of the Northwest sat down at a banquet in the Auditorium main hall last November in honor of President Taft. It is brilliantly illuminated and contains within its walls every convenience for the exhibitor and visitor. The doors will be thrown open on Tuesday evening March 1st and close Saturday night March 5th.

"The St. Paul," the new million dollar hotel will be completed in ample time for the convention. It is the first million dollar hostelry erected in the Northwest. A twelve story fire-proof building of the most modern type, upon the roof of which will be installed the first commercial wireless station in the West. It contains three hundred outside rooms, with bath. A handsome garden will occupy the roof of the building, with an outlook over the striking panoramic view of parks, the Mississippi valley and river scenery. On the first floor will be a handsome palm room, parlors, spacious lounging rooms and office. The decorations will be artistic, beautiful and striking. The entire building is fire-proof. Ten thousand barrels of Portland cement will be used in its construction. It will rank with the finest and most modern hotels in America. For information address either Martin T. Roche, President, or A. E. Pfiffner, Secretary, St. Paul, Minn. Diagrams of the floor, cost of space and other information will be published in a later issue of this magazine.

MR. PFIFFNER ELECTED SECRETARY.

The Board of Directors of the Northwestern Cement Products Association unanimously elected A. E. Pfiffner, St. Paul, Minnesota, as Secretary to succeed J. C. Van Doorn, Minneapolis, resigned. A vote of thanks was extended to Mr. Van Doorn for the good work he done in behalf of the Association, and for the persistent efforts that he made during the past year in its interests. Everyone regrets that press of business made it impossible for him to continue in the office of Secretary; still the Association is extremely fortunate in Mr. Pfiffner's election to the office—he is extremely well adapted to take up the duties dropped by Mr. Van Doorn, as he is an old time concrete machinery man and has a vital interest in its success.

A NEW WORD COINED.

There is a growing tendency to call the larger particles that go into concrete with sand and cement, aggregates, when in fact the whole mixture is the aggregate or sum.

A very close study of the word fails to reveal any definition that would imply that it could be used as a name of an object and since the broken stone, slag, cinder or other things put in with the cement and sand are objects, such a term that means the whole is out of place. Hence, I suggest the word copard to mean anything of a larger size that will be used in concrete with sand and cement.

Copards are the co-partners of the sand and cement to make up the aggregate or sum total which is the concrete. Using the word in a sentence something like this: "The copards in the concrete mixture were slag" or "A washer for copards should be built near the source of supply." Or, if no new word is needed do not use aggregate as it is confusing and improper.—W. D. Browning, Collinwood, O.

HOW TO MAKE CONCRETE BLOCKS WITH WET MIXTURE.

Sir: After years of experimenting we have found a simple and practical method of manufacturing wet mix concrete building blocks, which method we believe will give concrete building blocks a place beside other first-class building material.

The molds are filled with a rather stiff wet mixture of concrete. The facing for the block should be one part cement, and one and one-half parts coarse sand, which should also be a rather stiff, wet mixture. The facing is placed on the block in a ridge through the center the full length of the block. A piece of moistened cheese cloth that is wider and longer than the mold is then spread over the mold, and the face plate, which is perforated, is pressed on the cloth, the impression made, the face plate is removed and the cloth is stripped from the block.

A simple way of testing the method is to cover a little facing material with cheese cloth, and make an impression with a piece of carved molding.

The cost of 24-inch blocks based on labor at $2.00 per day, cement at $1.40 per barrel, and sand at $1.00 per yard, the body of the block being a four to one mixture, is as follows: smooth face piece, five cents; hammered face piece six cents; and the rock face piece, eight cents. The full block (two pieces) smooth block, ten cents; hammered face, eleven cents, and the rock face, thirteen cents.

More defective walls are built by the use of too much lime in the mortar than any other cause. Mortar for wet-mix blocks requires but little lime, as the blocks are practically waterproof.

In all the walls made with one two-piece blocks the vertical joints are at the center of the open spaces in the walls, which is an advantage, as all vertical joints should be pointed or plastered over on the inside of the wall to insure a tight joint.

The molds are sanded before they are filled with concrete. The sides are higher than the ends in order that the face plate may be held in position when the impression is made. Wet blocks can be made faster and with less hard work than dry blocks, as there is no tamping and they do not require sprinkling and care after they are made.

W. D. Moore & Son,
Creston, Iowa.

The Hardening Process of the Calcareous Hydraulic Cements.

BY DR. W. MICHAELIS, SR.

(Concluded from September issue.)

In the case of a Hydraulic Lime, Chaux Lafarge 1, which was treated in the same way in the proportions of 1 gram to 3 liters of boiled distilled water, previously carefully neutralized by a small addition of lime-water, 0.3612 gram calcium oxide went into solution. No swelling occurred, because the solution contained only 0.1204 gram calcium oxide per liter. Then the concentration of the lime-water was increased to 0.2311 gram calcium oxide per liter; also in this case no hydrogel was formed and no calcium oxide adsorbed. Only after the contents of lime was increased to 0.439 gram calcium oxide per liter, swelling set in. The amount of lime adsorbed was 0.0319 gram calcium oxide, that is to say only about 3 per cent of the quantity of hydraulic lime used for the experiment.

From this can be seen that, after hydrolysis has taken place, in all cases approximately mono-calcium compounds remain, which appear to be very stable. Hereby the contents of anions or formers of anions in the residue increases. The insoluble residue, therefore, is charged electro-negative after the cations, calcium oxide, potassium oxide and sodium oxide have been extracted partially or entirely. As soon as the concentration of the lime-water has reached a certain degree, the calcium cations travel to the anions, about in the same manner as iron filings are drawn to a magnet, or the ions are attracted one by the other. Calcium hydro-silicate forms rapidly as almost insoluble compound, which is invariably precipitated as hydrogel, whereas calcium hydro-aluminate and calcium hydro-ferrite, which are slightly more soluble, form more slowly and take the shape partly of minute crystalline bodies and partly of hydrogel.

After this preliminary study of the decomposition of cements by water and of the action of calcium oxide upon the decomposed residue, let me try to explain the setting and hardening process of Portland cement. As an illustration we may use a group of three grains of calcined cement which are represented in the cuts as spheres magnified many thousand times, although they are in reality irregular, sharp-cornered, more or less porous little grains. To these three grains of Portland cement we add, in accordance with actual practice, the customary 2 per cent of gypsum represented in Fig. 1 by a small sphere. We have now to consider the effect of one-third of its weight of water or of about the same volume of water upon this cement: As said before, the calcined cement represents a "solid solution" over-saturated with lime, that is to say a mixture of fused compounds of silicic acid, aluminum acid and iron acid with calcium oxide, in which a certain percentage of uncombined calcium oxide is partly dissolved and partly enclosed; this solution became solid upon cooling. The water with which the cement is gauged immediately dissolves calcium oxide, calcium aluminate, calcium sulphate, alkali-silicate and possibly also a small amount of calcium ferrite; thereby an over-saturated solution is formed which contains calcium oxide, tri-calcium aluminate, tri-calcium ferrite and calcium sulphate. The last named salt combines with the tri-calcium aluminate and forms calcium sulpho-aluminate as long as gypsum is available, since every per cent of alumina requires 5 per cent of gypsum for the formation of this double-compound. If alite happens to be in a cement clinker, a crystal formation occurring in slowly cooled clinker, while my fused and quickly cooled Portland cement did not contain any alite crystals at all, this alite is decomposed by the water at once. Calcium oxide and calcium aluminate go into solution, whereas silica remains insoluble in the form of hydrate or hydro-silicate low in lime, because it is absolutely insoluble in lime-solutions, even if the latter are very diluted. Thus the small amount of water with which a cement is gauged is immediately transformed into an excessively over- saturated solution of various salts which react one upon another. The resulting compounds, however, owing to their insolubility in concentrated lime-water, form imperfectly built clusters of needle-shaped crystals radiating from various centers. Owing to the slow formation of the calcium hydro-aluminate and of the calcium hydro-ferrite these latter occur also in hexagonal minute plates.

This is as far as the process of crystallization goes which is identical with the setting and hardening process of gypsum (see Fig. 2). By this process setting and hardening of a cement may possibly be effected, but by no means can a hydraulic cement, that is to say a water-resisting mortar, be formed in this way, because the water surrounding a mortar made up merely of inter-

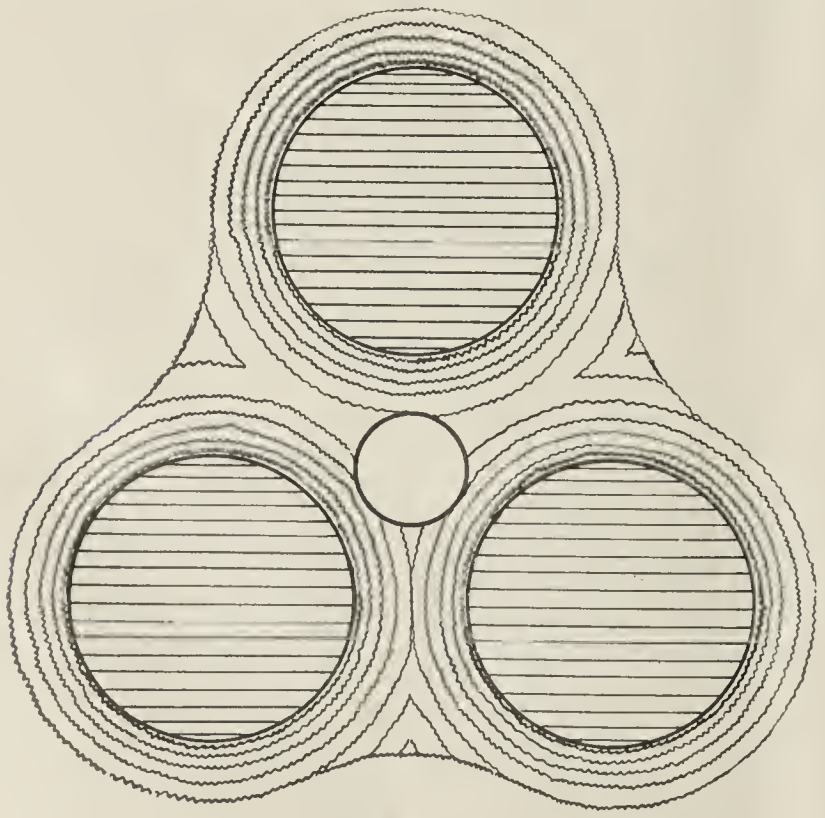


Fig. 1.

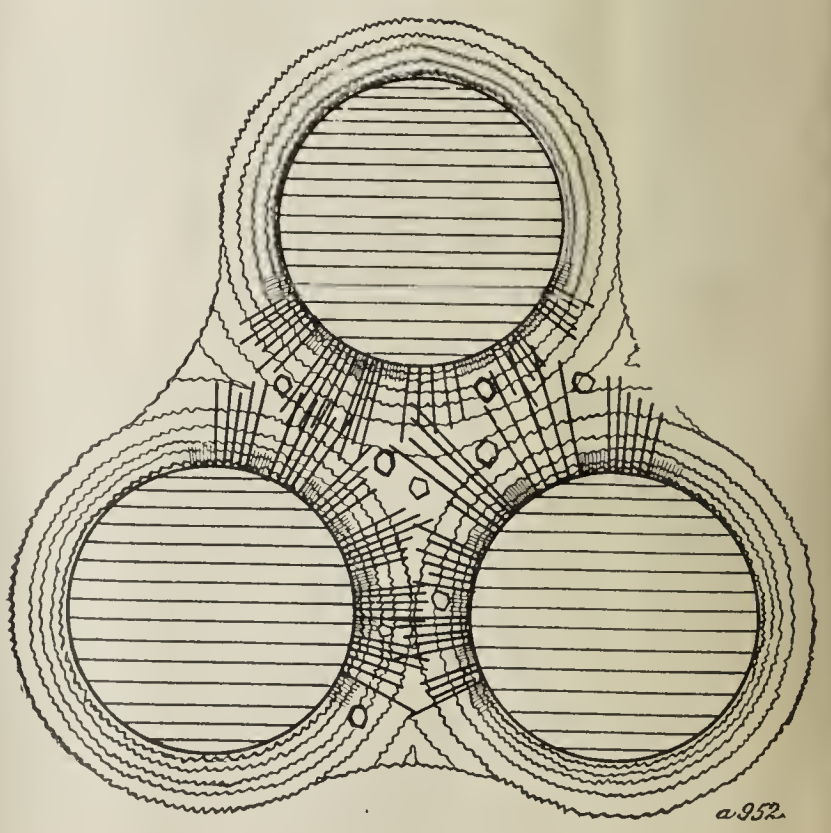


Fig. 2.

cking crystals, as in the case of hardened gypsum, is le to penetrate the hardened cement at all times. The ater, therefore, would be in a position to soften, dis- lve, and completely destroy the mortar.

The absolute proof for the fact that this crystalliza- on is not the hydraulic hardening process proper is be found in the observation that the silica never kes a part in this process of crystallization. We know om experience, however, that for the formation of a ydraulic mortar no other elements are required, but lica and calcium oxide. The same silica, via humida arata sicca, with about 13 per cent of water, or the ono-hydrate containing 23 per cent of water, which are ansformed into hydrogel, into a thick gelatinous mass, hen in contact with lime-water, result in a hardened olloid or gel, if mixed with lime-paste in the same man- er as a puzzuolana. The silica resulting from chemical nalyses, that is to say silica precipitated in the wet ate and calcined over a blast-lamp at 1400 Celsius, at ie same temperature at which Portland cement is burnt, i thoroughly mixed with lime-paste and dried be- ween towels or filter paper in order to remove the sur- lus of water, yields as hard a gel as neat cement mor- ar does. By this has been proven long ago that col- oidal calcium hydro-silicate, calcium silicate gel, is able o attain great hardness and strength.

We know that, in the presence of a sufficiently concen- rated lime-solution, calcium hydro-silicate can only be ormed as colloid, as hydrogel, on account of the rapid- ty with which it forms and because of its insolubility. Furthermore, we know that also calcium hydro-alumin- te and calcium hydro-ferrite are precipitated as hydro- els from excessively over-saturated solutions owing to he difficulty with which they dissolve in concentrated ime-water. The faster over-saturated solutions are reated, namely with increased fineness of the cement nd by using a minimum of water for gauging, and the ooner the calcium compounds of silicic acid, aluminum cid and iron acid form, which are all nearly insoluble n lime-water, the more colloids and the less crystalloids are formed. All these points support my theory that he formation of colloids is the main factor in the hardening of hydraulic cements.

After the decomposing and dissolving influence of the water upon the freshly gauged cement has lasted for some time and after the previously described com- pounds have been formed, *a point is reached very soon at which, all of a sudden, the over-saturated solution surrounding the cement grains coagulates.* This is the point of time, when the water disappears on the cement pats and when the setting cement attains a dull surface, briefly the time when the setting proper has taken place.

The hydrogel formed is very low in lime in the begin- ning and acts in a similar way as the silica hydrogel; by loss of water it dries out and forms a solid, opales- cent mass, a dense colloid. In time, more and more cal- cium hydrate enters this colloid by adsorption, because the hydrogel permits only the water to percolate, but retains the lime (semi-permeability); with the grow- ing adsorption of lime the hydrogel becomes more and more dense, unplastic and solid.

In Fig. 3, the formation of hydrogel is given by the dotted lines. The crystals are now imbedded in the colloidal mass in the same way as splinters of wood or bristles of a brush would appear interspersed in a stiff glue. In the beginning the hydrogel contains a large amount of water and, therefore, is soft. The inside of the grains, however, extracts the water from the hy- drogel very readily and hydrates in the course of time. The water, therefore, enters into the interior of the grains, whereby the hydrogel on their surface solidi- fies and becomes a perfectly impervious solid colloid. (see Fig. 4). The same observation can be made with

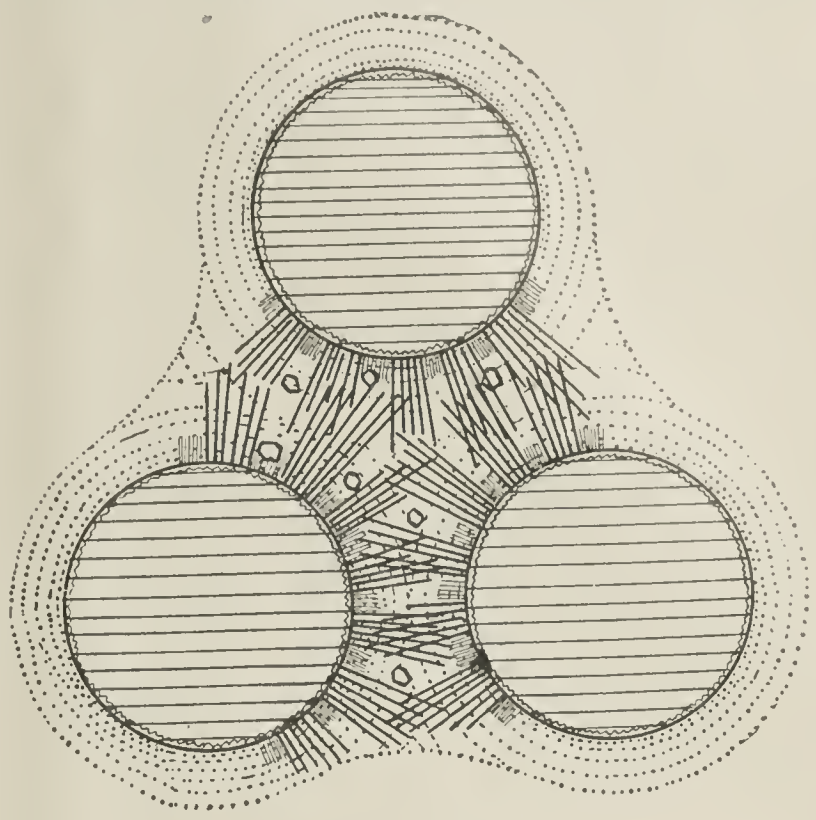


Fig. 3.

clay mud, which becomes an absolutely waterproof mass, if dried out on a water-absorbing plate or pad. This water-absorption from within explains the hardening un- der water and makes possible the steady increase in strength of the mortar. To what degree the calcium hydro-silicate gel hardens by loss of water has best been proven by Frederick Ransome's process of manu- facturing artificial sandstone, by which 90 parts by weight of pure quartz sand, consisting of grains of vari- ous size, are mixed with concentrated sodium water- glass in such quantities that 5 parts by weight of solu- ble silica are contained in it. This mass is moulded and then immersed in a correspondingly strong solution of calcium chloride, in which it hardens by the formation of colloidal calcium hydro-silicate originating from the reaction between sodium silicate and calcium chloride. The sodium chloride likewise resulting from this re- action is washed out by running water or in "rain

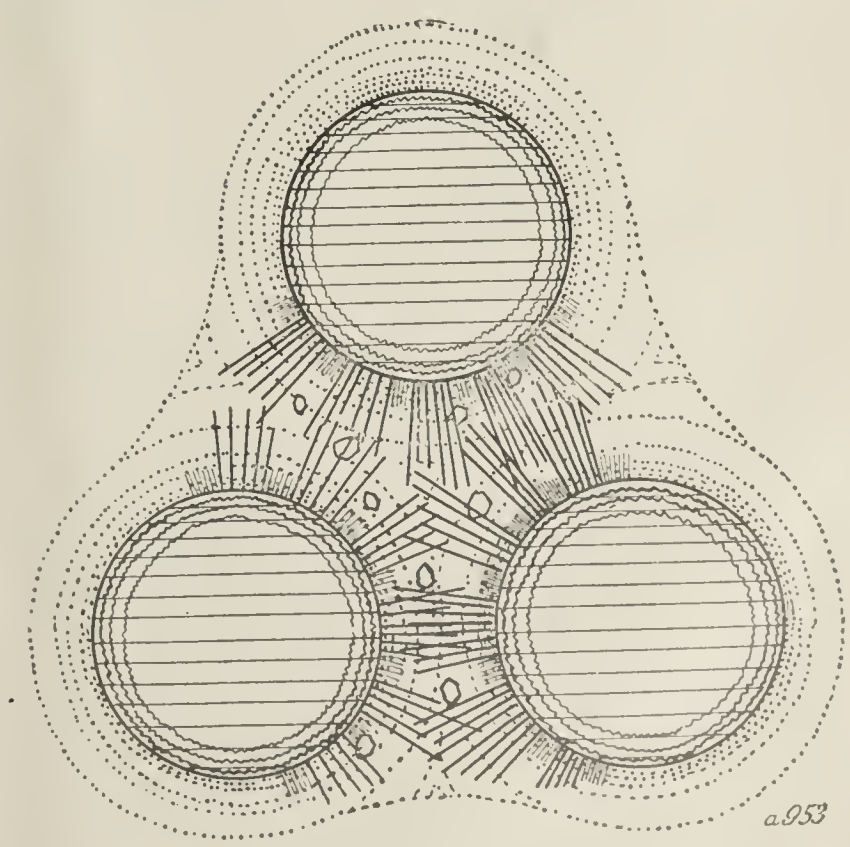


Fig. 4

chambers," and the artificial stone is dried in the air. This process yields an excellent sandstone of a compression strength of from 7,500 lbs to 9,000 lbs. per square inch. A mortar made in the proportions of 1 cement to 9 sand from the best Portland cement will never show more than a small fraction of this strength.

During the hardening process of cements, the strength obtained by the hardening colloids is further increased by crystallization of calcium hydrate, calcium hydro-aluminate, calcium hydro-ferrite and also calcium sulpho-aluminate, in case enough gypsum is available in the cement or is contained in the surrounding water; even large crystals of calcium sulphate are sometimes found. All these crystals are formed slowly from slightly over-saturated solutions.

In hardened Portland cement only tri-calcium hydro-aluminate and tri-calcium hydro-ferrite are to be found. In hydraulic cements lower in lime, for instance in Roman or natural cements also sesqui- and di-calcium compounds are liable to occur. The tri-calcium hydro-aluminate I obtained 30 years ago by dissolving in water any fused compound of aluminum acid and calcium oxide containing less calcium oxide than tri-calcium aluminate would contain and by subsequent admixture of an excess of concentrated lime-water; furthermore, it was obtained by violent agitation of precipitated and thoroughly filtered colloidal alumina hydrate with a large excess of lime-water. In both cases invariably within 24 hours hexagonal plates are formed which become noticeable, even if they are very small, through the peculiar reflection of the light resembling satin, if the solution is agitated.

The tri-calcium hydro-ferrite I obtained in the same way from iron oxide hydrogel precipitated cold and thoroughly filtered. The formation of this calcium hydro-ferrite is the cause of the disappearance of the rust from iron imbedded in lime mortar or cement mortar, which after a short time looks as if it was sand-papered or cleaned with an acid.

About 40 years ago I burnt as the first, as far as I know, barium cements by replacing the carbonate of lime by witherite, barium carbonate. The result was a cement much stronger than Portland cement on account of a higher specific gravity. A few experiments, however, convinced me in a short time that this barium cement was not a hydraulic cement; it was too soluble and was softened by water, because it owed its hardening mainly to a process of crystallization in the same way as gypsum.

The barium cement, therefore, is the best proof of the fact that hardening can take place also without swelling or formation of hydrogel. But it proves, furthermore, that without formation of colloids no hardening under water is conceivable.

Another feature characteristic for both, barium hydrate and strontium hydrate, which distinguishes them from calcium hydrate, is their action upon silica. Solutions of barium hydrate or strontium hydrate do not transform silica into a colloidal hydro-silicate, but into crystallized compounds. Moreover, no formation of hydrogel takes place upon agitating Portland cement previously decomposed by large amounts of water, that is to say the puzzuolana-like insoluble residue, with solutions of barium hydrate or strontium hydrate.

The experiments described in the foregoing are a further confirmation of what I declared in my paper read at the thirtieth annual meeting of the Association of German Portland Cement Manufacturers (in 1907*), namely that the formation of colloidal calcium hydro-silicate, and to a lesser degree also the formation of colloidal calcium hydro-aluminate and calcium hydro-ferrite, is the only essential and important feature in the hardening process of all known calcareous hydraulic cements.* The basis of all hardening under water is the formation of colloids, which originate from the reaction of a sufficiently concentrated lime-solution upon a puzzuolana. The water with which the cement is gauged decomposes the surface of the cement grain and extracts calcium oxide. This leaves the outside of the grain overloaded with formers of anions, especially with silica, and thus brings on formation of hydrogel.

In the case of puzzuolana proper, trass, santorin earth, Roman and Neapolitan puzzuolana, the drying out of the hydrogel takes place by the hydration of the puzzuolana. If, for instance, trass is thoroughly mixed with lime-paste so that each grain of trass is surrounded on all sides by lime-paste, that is to say that it is imbedded in a hydrogel, namely lime-paste, the lime-solution of the lime-paste reacts upon the anions of the powdered puzzuolana; for puzzuolana is a volcanic slag granulated by water and steam, a product rich in anion-formers and of electro-negative character in the presence of the calcium hydrate-cations. This volcanic slag, furthermore, contains hydro-silicates, that is to say products formed after granulation by steam and water had taken place, which can easily be decomposed, for instance analcime, natrolithe, phillipsite. All these harden readily with lime-paste, the calcium hydrate taking the place of the alkali. Through the absorption of the water of the lime-paste by the gradually hydrating puzzuolana the lime-paste becomes more and more dense and, in time, a solid colloid, while on the surface of the puzzuolana grains the hydrogel solidifies, which originates from the reaction of the lime-solution upon the electro-negative elements of the puzzuolana, in the same way as we observed in the case of the Portland cement grains. The conclusion to be drawn from this with regard to the application of puzzuolana mortars is the advisability of using lime-paste in the manufacture of puzzuolana mortars in preference to the dry powder of calcium hydrate. The use of the dry calcium hydrate must be considered as detrimental, because it sacrifices one of the main advantages of the puzzuolana mortar, namely its imperviousness to water before setting takes place, a property that it owes to the colloidal calcium hydrate and which prevents it from being softened and washed away upon immersion in water.

For about 100 years, since Vicat's time, it is known that alumina-silicates (clays and shales used by Polhem in the construction of the locks of the Goeta Canal in 1700), if de-hydrated at beginning red heat, yield very valuable artificial puzzuolanas. Upon expulsion of the water dissociation takes place; silicic acid and aluminum acid are liberated and each of them becomes capable of combining with bases. The aluminum acid, if previously heated at a low temperature is capable of combining with calcium hydrate and of forming tri-calcium hydro-aluminate which crystallizes in hexagonal plates. The silicic acid forms in contact with lime-solution colloidal calcium hydro-silicate of varying composition. As many as 3 molecules of calcium hydrate can combine with 2 molecules of silica.

For instance, pure white kaolin is a good illustration; if de-hydrated at from 600 to 700 Celsius, pulverized very finely and separated from the coarse by careful levigation and then agitated with a surplus of lime-water (for instance 1 gram de-hydrated kaolin with 3 liters of concentrated lime-water frequently agitated in the be-

ginning in order to prevent sticking together of the grains), in the course of one or two years, almost the total amount of aluminum acid can be transformed into the aluminate Al_2O_3, $3CaO,8H_2O$ (Michaelis) or $Al_2O_3,3CaO$, $1OH_2O$ (Dr. Gino Gallo) By heating at higher temperatures the ability of the aluminum acid of combining with lime in aqueous solutions is made more difficult and ultimately becomes impossible altogether. At the highest temperatures aluminum acid and silicic acid combine, so that even the latter does no longer combine with calcium hydrate.

For the calcium hydrate it was demonstrated in the foregoing that a certain amount had to be present in the solution in order to overcome the hydrolysis and the dissolving influence of the alkalies, which latter work towards the formation of soles, and to bring on the formation of colloids, principally of calcium hydro-silicate. For magnesium hydrate, which dissolves only in 55.000 parts of water at ordinary temperatures, this required concentration can never occur in water under atmospheric pressure. Consequently no one has ever observed puzzuolana hardening, swelling and formation of hydrogel caused by magnesia, and the statement that dolomite is more effective than pure lime in the manufacture of puzzuolana mortars is, therefore, erroneous; on the contrary the magnesia in it is merely ballast; it can form almost insoluble magnesia hydrate and finally magnesium carbonate, which latter is inferior to calcium carbonate, because it is more soluble. Only at high temperatures, in water under high pressure, can colloidal magnesium hydro-silicate be formed, or by chemical exchange between soluble magnesium salts and soluble silicates, for instance sodium silicate,water glass.

If the assumption is correct, that formation of colloids takes place only, if lime-water of a sufficient concentration acts upon silica in solution or upon compounds of soluble silica containing an excess of electro-negative elements, swelling, formation of hydrogel, ought to be out of the question, if concentrated lime-water is allowed to react upon lime-saturated or even with lime over-saturated compounds, for instance Portland cement. Experiments carried on in this direction showed in fact that the same Portland cement which, upon decomposition and extraction of its surplus of lime by a large amount of water, exhibited considerable swelling, formation of hydrogel, when brought in contact with a half-concentrated lime-solution, did not produce any signs of swelling, even if agitated for many months with saturated lime-water, 1 part of calcium hydrate to 1000 parts of water, or showed only a trace of hydrogel formation, if the cement contained a small percentage of alkali-silicate.

The hydraulic lime from Teil, Chaux Lafarge 1, and the Roman or natural cement from Trifail, upon being agitated with saturated lime-solutions, did not show any signs of formation of hydrogel. Finely pulverized sintered di-calcium ferrite, after having been agitated with concentrated lime-water for several months, was found to be hydrated, but did not form hydrogel, nor did it adsorb any lime; it, therefore, represented a compound saturated with lime. However, upon decomposition of the di-calcium ferrite with 1000 times its weight of distilled water, which extracted a certain amount of calcium oxide, and upon subsequent agitation of the residue with concentrated lime-water, swelling and formation of hydrogel set in. Likewise fused and disintegrated di-calcium silicate showed no swelling, no adsorption of lime, when agitated with concentrated lime-water. Only after decomposition with 1000 parts of distilled water and extraction of some of the lime from the surface of the minute grains, which therefore possessed a high percentage of silica, did formation of hydrogel occur upon addition of concentrated lime-water. The assumption that only electro-negative free ions of a certain minimum concentration produce swelling, that is to say formation of hydrogel, is proven by all these experiments. In opposition to this it may be said, that, if this were true, Portland cement could not harden with lime-paste, whereas such a mixture hardens very well as daily experience shows. The answer to this possible objection is that in the case of a Portland cement-lime mortar only hardening of the cement by formation of crystals enters into play and that the colloidal lime-paste offers the resistance to water, which otherwise the colloidal calcium hydro-silicate would do. A mixed mortar of this kind, however, is much more easily decomposed by the water, because the colloidal calcium hydrate alone is soluble in less than 800 parts of water, that is to say by far more soluble than the calcium hydro-silicate. Yet, the case is not as serious as it appears, because formation of calcium hydro-silicate sets in, if the colloidal calcium hydrate should be dissolved, namely as soon as lime-water acts upon the cement grains the surface of which was previously decomposed by water, whereby the contents of silicic acid, aluminum acid and iron acid increased. Of course, the mortar would become porous by the washing out of the calcium hydrate or in other words it would be less impervious to water.

That the foregoing explanations of the hardening process, as illustrated by the accompanying cuts, are by no means solely theoretical deliberations, has been proven by microscopical study.* However, the formation of colloids does not become visible in the first stages of the hardening, because the thin films representing the cell-walls of the gelatinous foam-like mass are perfectly transparent in the beginning. In the course of time these walls collapse, dry out and accept irregular forms. Only then the colloid becomes opaque and can be clearly distinguished. According to the amount of water used in gauging the cement, the hydrogel which forms contains more or less water and, as a consequence, is more or less dense. Its hardening, and at the same time the hardening of the hydraulic mortar as a whole, is solely effected by absorption of water from within, if the mortar is kept under water, that is to say by extraction of the water by the layers of the cement grain next to the surface which gradually become hydrated. The hydrogel covering the surface of the cement grain becomes denser and more solid by this process of water-absorption until a degree of density is reached where it becomes perfectly impervious to water. As an illustration of this process I mentioned in the foregoing the imperviousness of clay mud dried out on a water-absorbing plate. The hydrogel is finally transformed into a solid gel and thereby the inside of the cement grain is enveloped in an air-tight and water-tight coating, which excludes further action of the water or of the carbonic acid of the atmosphere upon it. The unaffected core of the cement grain, therefore, represents an inert mass imbedded in the

*H. Le Chatelier: Annales des Mines, 1887. II 345.
A. Martens: Mitteilungen der Koeniglichen Versuchsanstalt, 1897, p. 89.
A. E. Toernebohm. Ueber die Petrographie des Portland zements, Stockholm, 1897.
E. Stern: Chemiker Zeitung, 1908, No. 47 and No. 85.
H. Ambronn. Tonindustrie-Zeitung, 1909, p. 270.

mortar. This explains the phenomenon, to which I called attention 30 years ago, that a neat cement mortar, which was kept under water for several years, if once more finely pulverized, can harden again and obtain the higher a strength the coarser the cement was when gauged with water in the first place. Through the regrinding of the previously hardened cement the inside of the grains, which was not accessible to the water and therefore remained undecomposed became hydrated when gauged with water for the second time and thus could supply new cementing substance.

In my paper on the "Relative Value of Portland Cement" published in 1876 I demonstrated that Portland cement, which had hardened under water for four years, after being pulverized and made into briquettes for a second time, showed a tensile strength of 75 lbs. per square inch after immersion in water for 7 days, of 120 lbs. after 30 days and of 133 lbs. after 90 days.

These briquettes were finely pulverized, after having hardened under water for several years, and showed, upon being gauged with water for a third time, still a considerable strength.

Before I introduced the 200 mesh sieve into the cement industry, at a time when the commercial cement left a residue of at least 30 per cent on the 100 mesh sieve, the amount of the cement which did not take an active part in the hardening was very much larger than at the present time of course. At that time hardly 33 per cent of the cement was utilized, and yet my demand for fine grinding was bitterly opposed. I advocated for a mortar of 1 cement to 3 sand a tensile strength of at least 75 lbs. per square inch after immersion in water for 7 days and 120 lbs. after 28 days. This was found unreasonable at that time.

If a cement hardens in air, the hardening of the hydrogel is brought about by absorption of the water by the inside of the cement grains and by evaporation of water into the atmosphere. This loss of water increases the strength by complete transformation of the hydrogel into solid gel; however, rapid evaporation of water is accompanied by shrinking which manifests itself in all cases in which mortars exposed to the air do not contain enough sand or are gauged with a surplus of water.

At places, where the hydrogel is not dense enough, for instance in the hollow places in Fig. 3 and 4, or where by evaporation pores and interstices have been formed, water and salt solutions can enter and exert their dissolving and decomposing influence. Through the interstices, therefore, which were filled with hydrogel of too high a percentage of water, water and salt solutions (sea water) can further penetrate. Calcium oxide and, furthermore, aluminum acid and silicic acid can be carried into solution. These form, in the case of dormant water large crystals of calcium hydrate, calcium hydroaluminate, calcium sulpho-aluminate and sometimes also of calcium sulphate. Or in active waters, if a continuous current of water percolates through the mortar, all these compounds are washed out, whereby the mortar becomes honey-combed. Finally even the dense coating protecting the cement grains, the solid gel itself, may be decomposed and dissolved, so that the cores of the grains, which so far remained intact, are unprotected and are likewise exposed to the decomposing and dissolving influence of the surrounding liquid. The result may be that at last the whole cement is decomposed into its component parts, that all calcium oxide is washed away and that only a flocculent mass of colloidal silica, alumina and iron oxide remains, which may still be held in place by the pressure exerted by the overlying load and by the outer crust of the construction which became solid by the formation of calcium carbonate. This state of affairs has frequently been observed at large blocks immersed in sea water. Some violent shock is sufficient in a similar case to make the entire construction collapse at a single blow.

Or it may happen that the solutions penetrating into the hydraulic mortar react in the same manner as the magnesium sulphate of the sea water does, which is the cause of compounds that considerably increase in volume upon crystallization and thereby destroy the cohesion of the mortar by formation of cracks or by complete disintegration. If, for instance, only 5 per cent of the aluminum acid contained in a Portland cement is transformed into the double-salt consisting of 1 molecule tricalcium aluminate, 3 molecules calcium sulphate and 30 molecules of water, an increase of volume of 15 per cent occurs, which makes it obvious that the mortar is transformed into a mass without any cohesion whatever.

The formation of colloids in the case of all calcareous hydraulic cements, originating from the reaction of sufficiently concentrated lime-water upon the anions silicic acid, aluminum acid and iron acid, explains the otherwise surprising fact, that a mortar which, in the beginning, admits water becomes waterproof by the water entering its interior, although this water decomposes the cement and thereby may be expected to make the mortar porous. The percolating water extracts lime from the surface of the cement grains, thereby increases the electro-negative portion of the elements and, upon sufficiently high concentration of the lime-solution, closes the pores through formation of colloids.

In my paper on the "Constitution of Hydraulic Cements," read in 1906 before the Association of German Portland Cement Manufacturers, I still regarded these colloids as true chemical compounds and gave them formulas and named them vicatite, smeatonite and so forth, although I pointed out at that time that these colloidal compounds do not occur in stoechiometrical proportions as well defined as crystalloids. To-day I am of a different opinion, as a further study of the colloids has convinced me that they are heterogeneous compounds.

In the same way as in the dyeing process concentration of the dye-solution and duration of the process are the factors governing the amount of dye taken up by the fabric, or as in the leather tanning the same factors determine how much tannine is taken up by the prepared skin, thus the colloids behave which form out of silicic acid, aluminum acid and iron acid with calcium hydrate, as I explained 16 years ago. Even observation with the naked eye shows that gradually more and more calcium hydrate enters the gelatinous mass or precipitates on its surface. The formerly clear hydrogel changes, the cell-walls become less transparent and collapse in time. Chemical analysis reveals that the contents of lime of the hydrogel increases until finally the outside of it represents almost pure colloidal calcium hydrate (semipermeability).

This experience excludes any further thoughts of formation of chemical compounds in well-defined proportions. From these explanations the conclusion may be drawn that in hardened hydraulic cements calcium hydrate can occur only as colloid, while it is well-known that, for instance in hardened Portland cement, a considerable amount of crystallized calcium hydrate is to be

found. This is to be explained by the fact that only a certain amount of calcium hydrate can be precipitated and adsorbed by the silicic acid, aluminum acid and iron acid. The surplus of lime, the element with which Portland cement is over-loaded, can, in the course of the hardening process, gradually dissolve and crystallize from slightly over-saturated solutions. Thus the large crystals of calcium hydrate are formed which can frequently be observed in hardened Portland cement.

Now let us replace in our illustration the three Portland cement grains by three grains of glass-like, that is to say quickly cooled, slag which may contain on an average 27% of silicic acid, 15.3% of aluminum acid and 44.8% of calcium oxide, hence 45 molecules of silicic acid to 15 molecules of aluminum acid to 80 molecules of calcium oxide. In a similar slag the anions supersede. It is electro-negative, viewed from the electro-chemical standpoint, briefly it is a puzzuolana. Water is apparently without influence upon it, as it represents an almost insoluble calcium glass, a solid solution of calcium oxide, silicic acid and aluminum acid. Ground very finely and agitated with 1000 times its weight of water, hardly 1 per cent of calcium oxide went into solution. Solutions of sulphate of lime and of sulphate of magnesia did not act upon it. However, lime-water of sufficient concentration immediately starts formation of hydrogel. The resultant compounds are colloidal calcium hydro-silicate as the principal substance, furthermore calcium hydro-aluminate and a small amount of calcium sulpho-aluminate, because only little calcium sulphate is present. The amount of calcium hydrate adsorbed by the glassy slag out of the lime-water is rather small, in one instance it amounted to 6 per cent. The surface of the grains of the powdered slag, therefore must not be imagined to be composed of the former compounds of calcium oxide and silica, but silica hydrate or calcium hydro-silicate very low in lime, which is able to form colloidal calcium hydro-silicate with sufficiently concentrated lime-water.

In the case of slag dust, spontaneously disintegrated slag, on the other hand, from 4 to 5 per cent of calcium hydrate go into solution in 1000 parts of water, for such disintegrated slag contains free calcium oxide besides stable calcium compounds as calcium orthosilicate and calcium meta-silicate, akermanite and anorthite. Agitated with concentrated lime-water, it adsorbs only a very small amount of calcium hydrate without formation of hydrogel. It does not yield a hydraulic mortar.

Finally we have to consider foamy slag, obtained by incomplete granulation or by a specially directed process of granulation, whereby, in addition to glassy slag, also decomposed slag is formed. We can best form an idea of this slag by imagining one of the three cement grains of our illustration to be composed of the glassy modification and the two others of the decomposed kind which contains free lime. Distilled water extracts from 5 to 9 per cent of lime from this kind of slag. The decomposed residue adsorbs from 1 to 2 per cent of calcium hydrate from concentrated lime-water. This adsorption is accompanied by a slight swelling and formation of hydrogel.

If mixed with lime-paste in the manner customary for the manufacture of puzzuolana mortars, the glassy slag hardens very well, even if stored for many years, the slag dust yields next to no strength, and the foamy slag hardens very slowly and develops but little strength.

The "Hercynia" cement, which is granulated under a special process and is claimed to consist solely of slag, was agitated with 1000 parts of distilled water. The amount of calcium oxide extracted by the water was 5.5 per cent. The residue placed in concentrated lime-water adsorbed 7.25 per cent of calcium oxide accompanied by formation of hydrogel. This showed that this cement was able to give off to the water less lime than the glassy slag in it was able to adsorb.

It has been tried to explain the hardening of the slags, especially that of the puzzuolanas, by the contents of alkalies dissolved in the water used for gauging. This explanation, however, can not be accepted for every kind of puzzuolana hardening. The only decisive factor is the concentration of the lime-solution formed in the course of the hardening process. The alkalies rather counteract the hydraulic hardening because they form "soles" with silicic acid and aluminum acid, that is to say they dissolve these colloids. For the hydraulic hardening, however, only the formation of colloids is of importance, and this can only be brought on by calcium hydrate. The alkalies can contribute to the hardening only indirectly, as I explained in my paper read in 1907, namely by decomposing calcium compounds and by precipitating from them calcium hydrate, as for instance by the decomposition of the calcium sulphide contained in slags, or by transforming silica into the soluble state.

The hydraulic hardening, in my opinion, is a combined process of chemical energy, electric and surface energy, to which the former, as I believe to have demonstrated to every one's satisfaction, contributes the greater share. Chemical affinity between elements of opposite electrolytic character undoubtedly enters into play. Those, therefore, who conceived the hydraulic hardening process as a puzzuolana hardening, namely Chevreul and later Fremy, were right; for the formation of colloids is invariably the consequence of a reaction between a lime solution and silicic acid, aluminum acid and iron acid or with compounds from which these anions are set free during the hardening process. To the theory of these *scientists has now been added the explanation for the gradual progress of the hardening by water-absorption, by the extraction of the water of he hydrogel from within, which transforms the gelatinous plastic mass into a solid body, the hardened colloid, and thereby makes a water-mortar out of the cement.*

No matter what future investigations may prove with regard to the various physical states of a body, whether they consider colloids not fundamentally different from crystals, but merely the root of crystal formation, a stage in which the directing forces are not sufficiently pronounced or, on account of the rapidity of formation, have no time to develop, the colloidal state by all means represents a condition in which motion within the liquid is made very difficult, namely in the case of hydrogel, or in which motion ceases completely, in the case of the gel or hardened colloid. *These two stages, which are the origin for semipermeabilty and impermeability, are the cause of the stability of the hydraulic cements under water.*

A hardened hydraulic cement, however, does not represent the last stage of transformation. It is merely a temporary product created by the action of the water upon the calcined cement. The final state is reached only after all lime has been transformed into carbonate of lime and all anions into hydrates. Until this has been accomplished the chemical changes within a cement do not cease; and after this object is attained, the

hydraulic hardening process can commence over again, as the final products of this transformation, silica hydrate, alumina hydrate and iron hydroxide, upon being ground finely, yield again a hydraulic mortar, if mixed with calcium hydrate. This, however, would be without practical value, because the hydrates are mixed with so much carbonate of lime, formed during the hardening, and with large amounts of sand, added in the making of the mortar, that the strength obtained by a second hardening would be very small.

It is a well-known fact, that in the course of the reaction of the water upon hydraulic cements heat is generated, by means of which the progress of the hardening is determined. By the absorption of the water of the hydrogel on the part of the cement grain, which is used for the hydration of the inside of the grain, a further amount of heat is generated, that is to say a long time after setting has taken place. This shows that temperature measurements during the setting are not a reliable method of determining the end of this first part of the hardening process. In many instances I observed, as late at 24 hours after gauging of the cement, a renewed strong increase of the temperature. However, the maximum of the temperature curve may with sufficient accurateness be regarded as the time when the cement set. Both, setting and hardening, are caused by water going into chemical combination, the latter, therefore, is merely the continuation of the former and in fact both can not very well be regarded as separated processes. They are two terms in common use indicating nothing but the beginning and the final stages of the same process.

With regard to the accelerating or retarding influence of certain chemicals, of which small amounts are added to the commercial cement or dissolved in water with which the cement is gauged, my opinion is that these substances have been wrongly considered to act as catalyzers or catalysators for lack of a sufficient explanation of the manner in which they act. It was demonstrated in the beginning of this paper that the amorphous colloidal state is obtained by very rapid formation of almost insoluble substances, whereas crystals are possible only in the case of slow formation. These rules make it very apparent that all admixtures which bring on formation of crystals must necessarily retard the hardening process, and that, on the other hand, chemicals contributing to the formation of colloids must accelerate the setting. If silica in solution, for instance waterglass, is added to the water with which the cement is gauged, the formation of colloidal calcium hydro-silicate takes place very rapidly; the water is used for the formation of the hydrogel and, therefore, disappears at once. However, upon addition of gypsum or calcium chloride, crystal formation is the result. The water, utilized in this case as water of crystallisation, is adsorbed slowly. If alkali-carbonates are used as admixtures, the concentration of the lime-water necessary for the formation of hydrogel is reached more slowly, because the amount of lime going into solution is transformed into carbonate of lime. Furthermore, alkali hydrate is formed as a consequence of this reaction, which likewise retards the process by dissolving silica and alumina instead of precipitating them.

Finally a few words may be said about blowing cement. It suffices to sift a sample of the cement raw mixture, whether obtained by the dry or wet process, through the 200 mesh sieve, in order to be convinced that a perfectly homogeneous mixture of the raw materials can not be obtained in practical operation. The process of vitrification, of course, contributes to securing a more perfect mixture. But even by the clinkering process the inside of the coarser grains of calcined lime can never be reached by the fusing silicates surrounding them. The powdered clinker, therefore, must contain more or less uncombined lime, according to the proportions of the raw materials used. This free lime is bound to hydrate in the course of time. Upon entering of the water, extracted from the hydrogel, into the interior of the cement grain and subsequent hydration of the calcium oxide, an increase of volume, that is to say expansion takes place. If the cement grains are very small their surface consequently proportionally very large, the elasticity of the hardened crust around them will be able to overcome the pressure from within. In this case the expansion inside of the grain contributes even to the solidification of the mass and to an increase of strength. In the case of larger grains, however, the internal tension becomes so great that the coating surrounding the grains bursts. This is the cause of the blowing of a cement which can be observed only after the cement has set, for the reason that it can take place only after a certain cohesion and rigidity of the mortar has been obtained which is destroyed by expansion from within after plasticity and elasticity of the mortar mass have ceased to exist on account of water-absorption. The grains of a powdered cement resulting from an imperfect mixture can, therefore, be compared to brick with lumps of lime in them..

For 150 years chemists knew that the silica of many minerals, upon decomposition of the latter with acids, is obtained as gelatinous substance; but only 30 years ago* I recognized with certainty that, when silica combines with lime in contact with water at low temperatures, invariably a gelatinous compound is formed, namely colloidal calcium hydro-silicate. Since this was demonstrated another 30 years of experimental work were required in order to prove beyond doubt my theory published in 1907 in a paper read before the German Cement Manufacturers' Association which pronounced the formation of colloids in the course of the hydraulic hardening process to be the only essential and characteristic feature.

Through my paper of 1907 and through the present publication the hardening process has, in my opinion, been definitely explained. After a study of 45 years I feel confident to have succeeded in unveiling this mystery.

Sacramento, Calif.—In closing a contract with the Mount Diablo Cement company, to furnish the state with cement at $1.50 per barrel, State Engineer Nat Ellery has won his fight against the interests of California, which have in the past submitted no bid for less than $2 per barrel. When the bids were rejected last winter, Ellery invited all manufacturers of cement in the state to bid, but received no offer lower than the trust price.

To break this combine and save the state many thousands of dollars, Ellery had a conference with Max Figel, a San Jose jobber, who was general disbursing agent for the cement interests. Ellery forced him to reduce his estimates 25 per cent. with the threat that if they didn't submit that reduction the state engineering department would never purchase another barrel of cement from them.

*Journal Du Ceramiste & Chaufournier, Paris, March 22, 1880. Deutsche Toepfer & Zeitung, Berlin, 1880, p. 193.

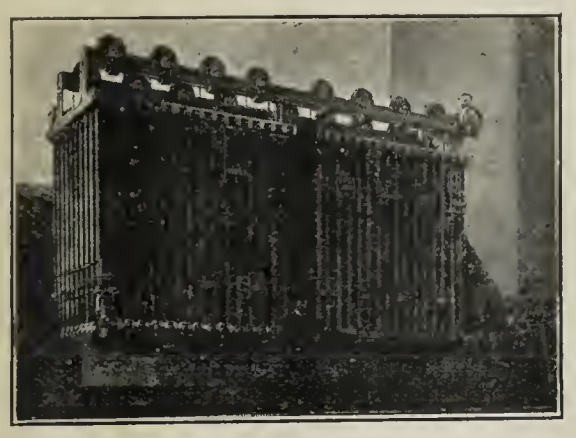
GREEN FUEL ECONOMIZER.

Below we publish a cut of a fuel economizer, made by the Green Fuel Economizer Company, of Mattewan, N. Y., which saves 10 to 20 per cent of the boiler fuel by utilizing the waste heat to preheat the boiler feed water.

The company state that:

"No matter what type of kiln you use, the temperature of the gases, if you burn dry rock, will be far above boiler temperature, and a comparatively small economizer will be able to recover from this source enough heat to replace 10 to 20 per cent of the coal otherwise required under the boiler.

"A Green Economizer will not only save coal, but it will increase the steaming capacity of your present boilers by about one-sixth, saving the cost, not only of additional boilers, but of the setting, grates, flues, piping, etc., required for them. If you already have sufficient boiler capacity the installation of the economizer will give you spare capacity, so that some of the boilers can be laid off for cleaning, repairs, etc.



"The Green Fuel Economizer is the result of over sixty years of experience and improvement. It is now installed in plants of over 50,000,000 horsepower. We control exclusive patents on the application of economizers in connection with cement processes.

"We also build mechanical draft fans for boilers, and have installed some of the largest now in operation. Fan draft will enable you to burn economically the cheapest varieties of coal, will increase the capacity of present grates and furnaces, and will give perfect control of steaming, regardless of weather conditions.

"We shall be pleased to submit suggestions or to propose the most economical layout for your plant upon receipt of particulars. Ask for a copy of our 160-page treatise, "C. E.," on "Steam Plant Economy."

MIRACLE'S NEW CATALOGUE.

The Miracle Pressed Stone Company, of Minneapolis, Minn., have just issued their new 1910 catalogue. That it contains a lot of up-to-date and valuable information for the concrete worker is a foregone conclusion, as this enterprising concern has an established reputation for getting out publications of merit, and which contain much information of value to their customers and the trade in general. Each succeeding year sees many new items of interest added to their already complete line.

Some of the new machines and equipment described in this new catalogue are the following; Miracle Positive Feed Continuous Mixer, mounted or unmounted, with or without power; Reducers and Increasers for concrete sewer pipe connections; Collapsible Steel Forms for continuous sewer, conduit and culvert construction; New Ornamental Molds; Revolving Power Sand Screen; Miracle Fence Post Machine; Miracle Adjustable Steel Burial Vault Mold; Miracle Magic Tamper.

These are only a few of the more interesting and important items of interest shown in this catalogue, and we believe every concrete worker and contractor should have this book for reference.

The price is 25 cents, but it will be sent free to readers of Cement and Engineering News. Address Miracle Pressed Stone Co., Minneapolis, Minn.

PUMPING WATER 350 MILES.

The greatest difficulties experienced by the metallurgists in the West Australian gold fields arose from the scarcity of water. The mines were situated in arid districts, between 300 and 400 miles westward from the sea and coastal rivers, and the only sources of supply in the mining camps were the mine waters, mineral springs, and desert salt pans. All the ground water was full of alkali and the miners were compelled to distill the alkali water to obtain supplies for drinking and domestic purposes. The scarcity, however, was remedied early in 1903. The government clearly recognized the economic value of the gold discoveries and, while the mining boom was on, boldly undertook to supply the principal mining communities with good water. Its scheme was, in addition to being the greatest of its kind, unique in other respects. The estimated requirements of the fields amounted to 5,000,000 gallons per day. After numerous surveys had been made, it was determined to run a weir across the Helena river, near Mundaring, and pump the water thus collected in two and a half feet riveted steel conduits, a distance of 351½ miles to Bulla Bulling. A concrete weir 760 feet in width and 100 feet in height was constructed across the river. This formed a reservoir with a storage capacity of 4,600,000,000 gallons, and a daily output capacity of 5,000,000 gallons. The main service reservoir from which the towns and mines of the gold fields are supplied is situated at Bulla Bulling, twenty-one miles eastward from Coolgardie. This reservoir has an elevation of 1,290 feet above the level of the Mundaring reservoir. The water is pumped from Mundaring to the Bulla Bulling reservoir by steam pumps operating in eight sections and from as many intermediate reservoirs or storage tanks. These pumping stations handle daily over 5,000,000 gallons of water, weighing approximately 22,300 tons. From Bulla Bulling the water is distributed to numerous centers by gravity through steel conduits.

The Farm Cement News is the title of a pamphlet issued by the Universal Portland Cement Co., Commercial Bank Bldg., Chicago, Ill., giving a number of hints for utilizing cement for farm buildings. Send for one.

The Past Master General of the Australian Confederation approved of an order for tenders for 1,000 reinforced concrete telegraph poles, a London Company having previously quoted a price of $40.75 each for 60 reinforced concrete poles to be made on the ground, where the poles are to be erected.

The object of the asking for tenders of other makes of reinforced concrete poles, the bids are being renewed at Sydney, New South Wales, Australia.

W. W. Wheeler, superintendent of the United Portland Cement Co., Iola, Kans., has gathered 200 negroes from different parts of Oklahoma to work at the plants. Every summer an excursion of this kind has been made in the last 5 years or so to keep up the number of the mill forces.

Mr. Earle S. S. Smith resigned his position as manager of sales for the Bonner Portland Cement Co., on September 15th. He has accepted a position as manager of the Yale Amusement company of Kansas City, Missouri.

THE PAULY CONCRETE HOLLOW TILE.

About a year ago a brief description of the concrete hollow tiles invented by Mr. A. A. Pauly, of Youngstown, Ohio, was published in this journal. Since that time these tiles have been used in the construction of many buildings, and they appear to have sustained the opinion of experts as to their practical value in that field. There is nothing complex about the tiles. They are perfectly simple in design and methods of use, and in that respect they are quite remarkable and by many are regarded as among the most important of recent inventions having to do with concrete. They answer every purpose of the terra cotta tile, but have several important advantages. A plant may be quickly and easily established, as no burning is necessary as in the case of clay or terra cotta tile. The cost does not equal that of the terra cotta tile and in construction a wall may be laid at less cost than terra cotta tile or brick. A decided advantage is the fact that plaster or stucco applied to the concrete tiles becomes practically an integral part of the latter. A good job means that the plaster will stick. Equally important is the fact that the concrete tiles are waterproof. Of extreme importance is the fact that the tiles are fireproof. These are

Built of Pauly Concrete, Hollow Tile and Stucco Exterior.

the salient features of the tiles as an improvement upon other materials.

These tiles, however, possess other interesting features. In seeking to devise something thoroughly practical and economical, the inventor did not take into consideration the artistic side of the problem, but as is frequently the case, that merit developed because the highest point of utility was sought. In other words, given proper joints, the Pauly tiles present a pleasing surface without special treatment or application of plaster. They resemble closely the gray terra cotta facing used on many large and costly buildings. One pattern, a narrow tile with three-inch face, would look extremely well set with wide joints. This tile would give a twelve-inch wall both fireproof and waterproof. Other compact tiles with two compartments may be set one upon another and filled with concrete to form a column pier.

The tiles are admirably adapted for one and two-story structures from foundation to roof. Used as curtain walls they will find a place in buildings of the skyscraper type. In this respect they will be of special interest to the engineer and architect engaged in that class of constructon. At present their use in the construction of dwellings is a matter of special interest. So much has been said upon the subject of economical and fireproof dwellings that the tiles should appeal strongly to the thousands of architects engaged in designing houses of moderate cost. The tiles facilitate rapid construction. As stated, they are fireproof and waterproof. With a stucco finish they solve the problem of a beautiful house at low cost as compared with other material equally substantial. This has already been demonstrated in spite of the fact that the hollow concrete tile industry is in its infancy. Moreover, there is the promise that architects will devise ways and means of using the tiles that even their inventor has not considered.

It would be an easy matter to make special shapes for column and wall construction. As stated, the great value of the Pauly invention consists of its simple and thoroughly practical features, something already satisfactory from every point of view, but which may be further adapted to artistic expression, just as in the case of bricks. While in the form of units, they represent practically a monolithic mass with their span of twelve inches set in good mortar. Turned on end and filled with concrete, we have the solid column. The air space may be used in wiring. The narrow tiles make ideal partitions. And yet, the entire process, from the manufacture to the laying of the tiles in wall, floor or columns, is exceedingly simple.

At Youngstown, Ohio, where the tiles are made, upwards of 1,500,000 have gone into all kinds of buildings, from small cottages to the most valuable business properties in the city. Many examples of houses constructed of these tiles are shown herewith.

Youngstown was one of the nineteen cities in the United States which showed a fire loss for the year 1908 exceeding $100,000. In 1907, its per capita fire loss, $7.52, was exceeded by but five cities in the country. These are facts which demonstrate the utmost need of fireproofing material in building and show why the Pauly concrete tile is meeting with such favor in Youngstown in the building of homes as well as business blocks.

The structural tiles are cast or molded by specially designed machines in steam-heated molds, the materials having first been properly proportioned, mixed and prepared for pouring. Excess water being driven off as steam, the tile is ejected from the mold mechanically, and then annealed or cured in an oven provided with steam connections giving a definite progression of heats and moistures so as to secure quickly the complete and perfect crystallization of the concrete material. The finished tile has the minimum porosity for the absorpton of water obtainable in concrete, while at the same time the highest fire resisting quality is attained, both being due to the extreme density of the concrete produced by the process. The corners, edges, angles and plane surfaces of the tile are all mathematically correct, and Mr. Pauly claims that the economic uses for such materials are apparent to every practical constructor of buildings.

Exhaustive tests have been conducted to establish the structural value of this new building material, to prove its strength in compression, the amount of absorption when immersed in water, and its resistance to fire—these being the three elements of importance to be considered in every building material. All such tests have been conducted publicly upon a practical and thorough basis, and every one of them has demonstrated this type of concrete tile to possess the highest qualifications in each of these requisites.

Using exclusively the product of standard machines, the foundations, walls, floors and roof of a residence can be constructed of fire-resisting materials at a cost practically parallel with construction that uses wooden studding, sheathing and siding, with a shingle roof. The latitude for artistic expression in the trim and finishing of tile constructed homes is limited only by the genius of the designer and the desire of the builder.

A typical example is a house in which tile 8 x 8 x 16 inches were used for the outside walls. Tile 4 x 12 x 12 inches were used in all partitions, and the first floors throughout are made of tile and reinforced concrete construction, reinforced joists being placed between alternate rows of 4 x 12 x 12 inch tile. The floors are six inches from the upper to the lower surface. The foundation measures 28 x 34 feet and is a modern eight-room residence. The outside plaster consisted of a coat of cement mortar applied directly to the surface of the tile, and the finished coat was made with a mixture of Portland cement and hydrated lime.

In the house described the walks, driveway and steps as well as the porch columns are of concrete. Such a house is built for $4,000. It is finished inside with hardwood, plate glass windows and doors, with slate roof and six massive pieces of built-in furniture of elegant design, with plate mirrors, etc., all included in the figure named.

Carpenter-contractors made a competitive bid on this residence to use 2 x 4 inches, studding and sheathing and siding for the walls, with identically the same visible interior finish and furniture in place. The lowest bid of this character of construction that could be obtained was $5,500.

Residence Built by Pauly Concrete Hollow Tile, with Stucco Exterior. Shows the Pleasing Architectural Appearance. This House is Waterproof and Fireproof.

As stated, Mr. A. A. Pauly, general manager of the Concrete Stone and Sand Company, of Youngstown, is the inventor and patentee of the system and machinery for manufacturing structural tile by pouring a liquid concrete mixture into a heated molding apparatus, and his concern is the sole manufacturer of the machine, and their lessees alone can operate with this fully patented and protected system for manufacturing the tile.

A company has already been incorporated by New York capital to build a plant in the metropolis with a capacity of 3,000,000 tile per year by means of the Pauly machinery. The incorporators include some of the prominent engineers of the city, all of whom have visited the Concrete Stone and Sand Company's plant in Youngstown and witnessed tests of the product.

CONCRETE APPLIED TO DWELLING HOUSE CONSTRUCTION.

By Ross F. Tucker, M. Am. Soc. C. E.

The next step in the extension of the use of concrete will be its adaptation to the construction of dwellings. With the army of block machines that are on the market, and the great quantity of the "output" from these machines, the bulk of which goes into dwelling house work, it might be asssumed that the step above mentioned had already been taken. In a sense it has, but it is a step that, in the writer's opinion, has done concrete a questionable service. The technique of the method of manufacture to which all block makers are restricted is fundamentally wrong and can never be of

great value, either constructively or decoratively. The ten or twelve per cent of water used in mixing is not sufficient to lubricate the particles of aggregate, nor to develop the full set of the cement. Such material cannot possibly have the density nor the strength of a properly made concrete. All the ramming and tamping in

Residence of Mr. Sharp at Youngstown, Ohio, Showing Pauly Concrete Hollow Tile.

the world, all the pressure that can be exerted by hydraulics or otherwise, will not compress a dry-made concrete into a dense, water-tight block. The particles of aggregate arch on themselves and cannot be forced to fill corners and interstices without sufficient lubrication to allow the faces and surfaces of the aggregate to slip on one another. On the other hand, the moment that sufficient water is added to secure the best results for density and strength the material is too soft to be removed from the moulds and the so-called block machines are of no value at all. It is curious that so many people have taken to block-making, as if there were something new about it.

The old-fashioned artificial stone of thirty years ago was made of the same material and in the same manner as with block machines today, and the resultant material had all the defects of these later productions—a soft, absorbent, spongy mass of low compressing, strength, requiring all sorts of treatments to make it waterproof. The whole practice is wrong and the only difference between the old method and that of today lies in the numerous mechanical devices, which, with greater or lesser ingenuity, reduce the labor and mould cost to a minimum. By reason of the faults that lie at the very beginning of all block-making I do not consider that the steps taken in that direction have been of any great value to the industry as a whole, nor need we expect anything of importance to come out of it in the future. All walls built of such material must be so constructed as to avoid the dampness that such concrete must necessarily acquire, and the very softness of the stone precludes any surface treatment that can be called interesting or satisfying to any degree.

All concrete, to be strong and sound, must be wet concrete, far too wet to be delivered from its mould for considerable periods of time. The best artificial stone made in this country today is manufactured in Boston on a wet process principle, that must necessarily lie at the bottom of any concrete worthy of the name. The principle of selection of aggregates combined with intelligent combination and mixing secures results that in a finished product are astonishing and absolutely impossible of attainment by any dry process block-machine that ever was devised.

While we have about solved the problem of mill and factory building, both structurally and economically in reinforced concrete, the same cannot be said at all in respect to dwelling houses. In the mill and factory structure we have a relatively large amount of concrete as compared with the lumber and labor involved in the making of the forms, whereas, in the dwelling house, with the cut-up surfaces and irregular openings, the rates of cost of forms to concrete is out of all scale and proportion and puts concrete practically out of the running in comparison with other material. Moreover, the internal stress, particularly the shrinking of concrete masses, are such that concrete walls of this kind are almost sure to crack. They must be furred or an air space formed, as otherwise they will be damp and extremely unsatisfactory. In the fall and spring there is a likelihood of condensation on the inside of an unprotected concrete wall, and, last of all, it is a difficult matter to give a solid wall any architectural treatment that can be called satisfactory, except at very considerable expense.

The wooden house is, of course, a menace to commence with and should only be built as a last resource. Such a house covered with metal lath and furred has some excellent architectural possibilities, but when well-built will not be found to be cheaper than a rough brick wall, for the frame must be sheathed, papered, metal furred and lathed and covered with scratch coat of mortar before it is in condition to receive the stucco.

New Masonic Temple, Youngstown, Ohio. Pauly Concrete Hollow Tile Used for Fireproofing and Partitions.

This will be found to approximate closely the cost of brick work. Much has been said about the faults of stucco work, but like many other failures in the use of concrete they are traceable to the ignorance of the users rather than to the fault of the material. Stucco has been abused about as much as any other material that the writer knows of, but it will do good service every time if it is properly made and applied. I have placed it on the St. Lawrence River on tile, brick and lath surfaces, where it has been subjected to a yearly range of 120 degrees temperature for ten years, and it is as good today as when applied, although the plastering on the inside, made exactly the same way, of the same material, came off in pieces a yard square on the same walls within two months after it was applied.

Stucco should be made of selected material, not of the first dirty, clayey bank sand that comes to hand. There are great possibilities in the future of stucco when properly handled. But for this development must come a cheap wall. The writer had occasion to make a study of this problem of a cheap wall construction for stucco application for the late Stanford White, who, had he lived, would have taken some steps to show what can be done in decorative stucco. But all existing methods have been too expensive and we must devise a cheap, dry wall before we can make material progress in dwelling house work. The terra cotta wall is a relatively cheap wall, but its lack of fire resisting qualities, its tremendous expansion under heat, make it a dangerous wall, unless insulated and protected. The nearest approach to the ideal wall for concrete dwelling houses seems to have been worked out by A. A. Pauly, of Youngstown, Ohio.

He has a method of delivering wet concrete from moulds in a clever and very economical manner and seems to have solved the problem of handling wet concrete and producing a dense, strong building unit at a very low cost. He has already done considerable building, and his development will be watched with great interest. With such a wall, the extension and possibilities of concrete decoration are unlimited and the future will give us fireproof homes of high structural and architectural value at low cost. The method is so simple, the requirements of skilled labor are so greatly reduced, that houses of concrete, fireproof throughout, may be constructed at a price to compare favorably with wood, and upon the walls may be applied a great variety of color and texture effects, in stuccos made of many materials, enlivened with masses of color in Faience and Mosaic, that give the architect great opportunity for the exercise of his artistic abilities. It will create a school of design adapted to the material and be productive of a style of dwelling possessing individuality and character combined with durability and permanency such as we know little of thus far in our suburban architecture.

NEW BOOKS.

The sanitary features of country estates receive very much more attention now than ever before, not only in the matter of water supply and sewage disposal, but also in respect to many other features which our knowledge of sanitation has shown to have a considerable influence on the comfort and often on the health of those living on the place. In a book on "The Sanitation, Water Supply and Sewage Disposal of County Houses" Mr. William Paul Gerhard first explains in a general way the requirements of healthfulness in the country. The soil the sub-soil, surface drainage, outlook, surroundings, cellars, lighting, heating and ventilation, water supply, sewerage and plumbing, screening to keep out flies and mosquitoes and the care of houses and building all receive attention. The second part is devoted to an explanation of the methods of procuring and distributing a suitable water supply, and the third part discusses sewage disposal. The book is accompanied by a large number of illustrations, many of them drawn from the author's own practice, and will undoubtedly prove helpful to the owner of any country place who is interested in its thorough sanitation. (New York, D. Van Nostrand Company, $2.)

TRADE NOTES.

The Lehigh Portland Cement Co., is sending out to the trade a number of interesting booklets. Two of the recent issues are published under the titles, "From the Architect's View Point," and "The Ten Business Commandments, The Eleventh as Lehigh Would Have it." Copies of these booklets can be obtained by addressing the Lehigh Portland Cement Co., at any of the following offices; Allentown, Pa.; Rockefeller Bldg., Cleveland, O.; Traction Terminal Bldg., Indianapolis, Ind.; and Lawrence Trust Bldg., New Castle, Pa.

* * *

The Aquabar Co., of Philadelphia, has found its business expand, at such a rapid rate that to properly take care of contracts, present and prospective, it has turned over the entire selling agency to Girvan, Nachod & Co., who at present have headquarters in Philadelphia. The Aquabar Company will hereafter devote its entire time and energies to the manufacture of "Aquabar," the well known waterproofing.

* * *

The Marblehead Lime Company, Masonic Temple, Chicago, Ill., is circulating a booklet relative to the use of hydrated, high calcium lime in Portland cement mixtures for waterproofing concrete blocks, concrete walls, etc. "Crown Hydrate," the product of this company, is burned from a stone containing 98 per cent carbonate of lime, and is hydrated by a vacuum process. In these points it differs from ordinary hydrated lime, so that it produces an easy-working waterproof mortar, stronger than plain Portland cement mortar. When added in proportion of about one-fourth of the cement. A record is given of a laboratory test of a Portland cement and hydrated lime mixture in mortar, showing the variation in strength for different proportions of hydrated lime. An increase in strength is shown on the long time tests in mixtures up to 25 per cent hydrated lime.

* * *

The Atlas Portland Cement Co., 30 Broad street, New York, have just published three new books which they will be glad to send to the readers of this paper.

"The book, "Concrete Construction about the Home and on the Farm," is a new and revised edition of our former popular book, and contains many new uses for cement besides a number of valuable tables.

"Concrete in Railroad Construction" has been published with the idea of advancing the use of concrete for this class of work, and the data has been furnished by the various railroads, whose names appear in the book.

We have spent considerable time and money preparing these books, and believe that they are worthy of your serious consideration. The book on Concrete for the Farm is given away free: the other two books we are charging $1.00 a piece for."

CEMENT MILL ITEMS.

The construction of the new plant of the Crescent Portland Cement Company at Crescentdale, Pa., has been completed, and early this month the entire mechanical equipment and cement making machinery was thoroughly tried out. Everything worked perfectly, and it was decided to place the entire new plant in full operation at once, which was done. The plant is now working to its full capacity, as the concern has a large amount of contract business on its books. So much cement has been shipped during the past few months that the stock is almost entirely wiped out, which has necessitated a marked increase of production. The old plant has been operated steadily to its capacity, which is about 400 barrels per day, with more than this amount of new business coming in daily. The new plant has a daily capacity of about 3,500 barrels, so that during the remainder of this year at least the company will produce about 4,000 barrels of cement. In addition to these two plants the company is also operating a lime plant at the above place, and this industry is also being operated to its capacity to keep up with the business on hand. The general offices of the company are in the Farmers' National Bank Building, Pittsburg.

* * *

Efforts are being made, it is said, to locate in Europe J. P. Townsend, of Akron, O., who is promoter and president of the Chanute Cement and Clay Products Company, the $4,500 000 enterprise at Chanute, Kan., which is in financial straits. C. B. White, of Fort Scott, Kan., is in charge as receiver. Bondholders believe that Mr. Townsend can assist the receiver in disentangling some of the affairs of the concern and put it on a paying basis. Receiver White plans to raise $200,000 to complete the big cement plant, so it can be put on a producing basis. If this is done, it will save $2 000,000 already invested by bondholders, according to reports. Between $75,000 and $100,000 of the bonds are held by Akron capitalists, while the Cleveland Trust Company holds $1,125,000 on bonds as trustee for stockholders. The bonds are secured by a mortgage and will not be delivered until the plant at Chanute is completed and producing 5,000 barrels of cement a day. The assets of the company consist of an operating cement mill in a swamp near Bronson, Mich., and the uncompleted mill at Chanute, which is represented as being a very rich cement field. The bankruptcy petition filed at Fort Scott puts the company's assets at $2 000,000, with liabilities of $250,000. A number of Cleveland people are interested in the venture.

* * *

The Wolverine Portland Cement Company, Coldwater, Mich., recently re-elected the following officers: President, L. M. Wing; vice-president, Frank M. Rudd; secretary and treasurer, E. R. Root.

* * *

Southwestern sales offices have recently been opened at Wichita, Kan., for the Monarch Portland Cement Company of Humboldt, Kan. The mill has a capacity of 5,000 barrels per day and the entire investment, including the cement land of the company, is about $2,-000,000.

* * *

Philadelphia, Pa.—The "Edison Special" pulled out of Broad Street Station on Saturday morning, bearing a heterogeneous collection of some 400 contractors builders, architects and others interested in the use of cement, with a sprinkling of newspaper representatives. The management of the Edison Portland Cement Company had decided to show its patrons and friends how cement is made at its plant at New Village, N. J., and accordingly, became the host of the occasion to a large gathering. Several similar demonstrations had been made for bodies from New York and Boston. This was, however, the first expedition of the kind from Philadelphia. If the other visitors fared as well as those from Philadelphia and were blessed with as good weather, it may be taken for granted that they went home thoroughly pleased.

From the time the train left Trenton a succession of white-coated waiters from the dining car kept up a lavish distribution of eatables, potables and smokables, for there would be no time later, as the party was to start on its tour of inspection immediately upon arriving at its destination. Before leaving the train every one was supplied with a black muslin machinist's cap and a drab linen or khaki duster as a protection against the fine particles of cement which fill the air about the works and settle down thickly over everything like volcanic ashes. Any one looking at the party from the rear would have declared it was a band of the Ku-Klux Clan marching along. It was a wise precaution, though, for what clothes would have looked like afterwards without this protection can well be imagined.

* * *

H. A. Reilly, architect and engineer, has severed his connection with the firm of Wilson & Reilley, of Welland, Ont., and gone to Calgary, Alberta, to take a position with the Rocky Mountain Cement Company.

* * *

Montreal, September 16.—The interest in the big Canadian cement merger, included in the Canadian Cement company, by prominent London houses, was shown by the announcement made today that already $2,200,000 securities of the company had been taken up in London and from information received quite a large amount of the present public offering will be taken up in the center.

Major E. St. Aubyn, of London, a director of C. Meredith and Company, limited, who has been in the city for some days, has given his personal attention to the new merger on behalf of the London interests.

The numerous inquiries for the securities of the new company, according to local brokers, is due in a large part to the fact that all the properties secured by the merger will be contributing to the earning power of the company.

Some idea of the enormous output the new consolidation will have may be gathered from the fact that the output of 4,500,000 barrels stretched out in a straight line would cover 2,600 miles, practically the entire distance, in a straight line, from Montreal to Vanvouver.

* * *

Within sixty days the plant of the Golden State Portland Cement Co., at Oro Grande, Colorado, will be ready for operation. One 120 feet kiln is placed and when in operation plans will be prepared to erect three additional units.

* * *

The Freeborn Engineering and Construction Co., has the contract to design and construct additional concrete storage bins of 105,000 barrels capacity for the Dewey Portland Cement Co., Dewey, Oklahoma.

* * *

The Chickamauga Cement Co., W. P. D. Moross, treasurer and general manager, Chattanooga, Tenn., has completed the remodeling of its cement plants at Rossville, Ga. (a Chattanooga suburb), substituting tube mills for buhrs in the finishing department and making other changes in connection therewith. The completion of these improvements provides the company with one of the most modern plants for the manufacture of hydraulic cement in the country, besides materially improving the product.

JOSEPH S. IRVIN, OTTAWA, CANADA.

Mr. Irvin Was a Leading Spirit in the Promotion of the Big $300,000,000 Canadian Cement Merger and is one of its Proposed Directors.

INTERNATIONAL CEMENT CO. PLANT WAS INSPECTED.

With the recent amalgamation of the leading cement companies of Canada, and the formation of the Canada Cement Co., more than ordinary interest has been shown in financial circles in the cement industry, as an investment proposition, and, in order that their clients might be afforded reliable information relative to the prevailing conditions and future prospects of the industry, gained from an intelligent and practical investigation, upwards of seventy-five of the leading bankers and brokers of Montreal, together with representatives of Ottawa financial interests, visited the plant of the International Portland Cement Co., at Hull on Saturday. The party was representative of the banking and financial brokerage firms of Montreal, including a large number of the members of the Montreal Stock Exchange and the purpose of their visit was to inquire fully into the equipment, working facilities and general

prospects of the International Portland Cement Co., with the object of obtaining an accurate knowledge of the merits of the proposition represented in the cement merger from the investment point of view, as illustrated in this modern, well equipped plant, one of the largest included in the Canada Cement Co.

The interest already evinced in the affairs of the cement industry was well demonstrated in the large number present, while the exhaustive inquiries made, and the careful inspection of all departments of the plant was further evidence of the importance attached to the new enterprise in commercial circles. Immediately on arrival the party was conducted over the plant by Mr. Jos. S. Irvin, managing director of the International Portland Cement Co., assisted by Mr. C. A. Irvin, secretary of the company. Each department was visited and Mr. Irvin described in detail the system of operation, those present being afforded every opportunity of observing the various processes of manufacture from the time the raw materials left the rock and clay beds, until the finished product in the form of Portland Cement was made.

Members of the party expressed themselves as especially favorably impressed with the system employed throughout, the methods of manufacture, the complete and modern equipment and the despatch with which the entire works are operated, several of the speakers endorsing the claim repeatedly made that the International plant is without an equal on the continent. Following the tour of inspection brief addresses were given by a number of those present, the speakers referring in enthusiastic terms to what they had seen demonstrated, and paying many warm tributes to Messrs. J. S. and C. A. Irvin on the signal success which they considered had marked their efforts in the management of the business.

NEW CEMENT PLANTS TO BE BUILT.

The Tidewater Portland Cement Company, main office 115 Broadway, New York, plant located at Union Bridge, Maryland, forty-five miles from the city of Baltimore, has awarded a contract to the Fuller Engineering Company to design and construct a large lime plant, to be built in connection with their new 3,000 barrel Portland cemet plant.

The plans are now being prepared and construction work will commence on this lime plant immediately.

* * *

Right on the heels of the news of the combination of Canadian Portland cement companies effected at Montreal comes the announcement of the merger of a number of companies in western Ontario. It is stated that the new combine will be known as the Independent Portland Cement Co., with a capital stock of $10,000,000 and head offices at Toronto.

The Contract Record says that the following companies have agreed to enter the merger:

Brant Portland Cement Co., Ltd., Brantford, $500,000; Colonial Portland Cement Co., Ltd., Wiarton, $800,000; Hanover Portland Cement Co., Ltd., Hanover, $500,000; Imperial Cement Co., Ltd., Owen Sound, $300,000; Ontario Portland Cement Co., Ltd., Paris, $450,000; Bell's Lake Cement Co., Ltd., Markdale, $500,000; Superior Cement Co., Ltd., Orangeville, $500,000; Western Ontario Portland Cement Co., Ltd., Atwood, $500,000; and St. Mary's Portland Cement Co., Ltd., St. Mary's $500,000. In addition to these companies, several other concerns are expected to join the merger.

As will be noticed, all these companies are located in Western Ontario, and all draw their raw material from marl beds, instead of from rock.

* * *

Sacramento, Cal.—The Mount Shasta Volcanic Hollow Tile and Cement Company, capitalized at $1,000,000, filed articles of incorporation here today. The directors are Abner Weed, E. L. Williams, W. E. Tebbe, George A. Tebbe and R. S. Taylor. As its name indicates, the company tiling and building blocks. The plant will be located at some railway point near Grass Lake, where Abner Weed owns a large tract of land containing cement properties. The headquarters will be at Yreka.

* * *

Plans have been completed for a series of four new buildings to be erected by the Universal Portland Cement Company at their plant at Universal, Pa., This will increase the capacity of the plant to 10,000 barrels daily.

* * *

Binger, Okla.—J. H. Ayers of Hinton, Okla., has completed arrangements for a plaster mill, two and a half miles north of town. Work on the plant is expected to begin about Oct. 1.

* * *

P. J. Morgan has brought the controlling interest in Utah-Portland Cement Company and the Salt Lake plant will be remodeled and improved and its capacity increased from 350 barrels a day to 1,200 barrels a day. New machinery has already been ordered and the plant will be made one of the best in the country, with every modern facility for turning out the best grade of Portland cement. The deal means an expenditure of $200,000 in enlarging the plant, and another $200,000 outlay in getting materials and starting the business on a large scale.

Contracts for all of the new machinery have been let by Mr. Morgan and the plant will be closed from December 1 until about April 1, during which time it will be remodeled.

The Toltec Portland Cement Co., an Arizona corporation with a capital stock of $1,000,000, possesses limestone and shale property on the main line of the Mexican Railroad, 48 miles from the City of Mexico. This will be the third plant in Mexico, one near Monterey, in northern Mexico, with a daily capacity of 500 barrels. Another, in the vicinity of the Toltec Company's property, with a capacity of 300 barrels per day. With the present market price of Portland cement in Mexico, which figures around $4 per barrel, in gold, this proposition will prove an excellent investment. The officers of the company are: President, F. L. Larabee, Stafford, Kans.; vice-president, Alex. A. Sharp, Larned, Kans., and treasurer, F. D. Larabee, Hutchinson, Kans. Directors: Alex. A. Sharp, Larned, Kans.; F. L. Larabee, Stafford, Kans.; Charles E. Lobdell, Larned, Kans.; F. M. Sackett, Louisville, Ky.; W. S. Speed, Louisville, Ky.; A. Aitken, St. John, Kans.; S. C. Charles, Stafford, Kans.; F. D. Larabee, Hutchinson, Kans.; W. E. Burk, C. E., Louisville, Ky. The engineer in charge is W. E. Burk, residing at the Sanza Hotel, Mexico City, Mexico.

The Allis-Chalmers Co. received the contract for the complete installation of the Toltec Portland Cement Co., located at Tula, Mexico. All the machinery is driven electrically with direct connected motors. In the crusher department will be a No. 8 Gates crusher and screens; in the raw mill two ball mills and six tube mills 6 feet by 22½ feet; in the kiln department two 135 feet by 8 feet kilns, in the finishing mill 6-tube

mills. The daily capacity is figured at 1,500 barrels per day. The plant will have no powerhouse. Current will be supplied from a turbine power station nearby. The fuel to fire the kilns will be oil.

* * *

Dee Lanyon, of the Lanyon-Starr Smelting Co., Iola, Kans., has purchased 210 acres of land northeast of Bartlesville, Okla., along the Bartlesville-Dewey interurban line, for the purpose of erecting a Portland cement plant. Leigh Hunt, of the Hunt Engineering Co., Iola, Kans., is reported to be a heavy investor in this proposition. It is reported that Mr. Hunt will begin work on this new plant as soon as the Iowa Portland Cement Co.'s mill has been completed, which is expected will be within a month. Excavation and grading is to start this fall.

* * *

Mr. George W. Norris, vice-president of the American Cement Company, has confirmed the report that that company will build a $650 000 plant at Norfolk, Va. Work on the plant will be started at an early date. It will have a capacity of 2,000 barrels a day, or about 750,000 barrels a year. This will bring the total output of the company up to 2,700,000 barrels.

The Norfolk site is of immense value to the American Cement Company by reason of its strategic position. It is within easy access of an abundance of raw material, with adequate labor and cheap coal, and possesses excellent transportation facilities. Mr. Norris said the company had acquired lands and mining rights covering immense deposits of shell marle and clay, from which the cement will be manufactured.

In the matter of freight rates, the Norfolk plant will have its greatest advantage. The freight rates from the Lehigh Valley district to Norfolk, Newport News, Baltimore, Washington and Richmond vary from 30 to 40 cents a barrel. From Norfolk the most distant of these points can be reached by inland water transportation at a rate not exceeding 10 cents a barrel.

"The new works," said Mr. Norris, "will be financed through a subsidiary company under the title of the Norfolk Portland Cement Corporation. The American Cement Company will own a controlling interest in this corporation chiefly through ownership of common stock issued to it as a consideration for the transfer of the cement lands and the mill site on the Elizabeth river, on which the plant will be located. It is expected the plant will be commenceed in time to turn out cement for next year's trade."

Instead of making the Norfolk plant merely a branch of a larger corporation, the company has preferred to make it a strictly Norfolk enterprise, and for this purpose has secured a Virginia charter, which has just been granted, for "The Norfolk Portland Cement Corporation." The mill site and all the lands and mining rights, on which the raw materials are located, will be conveyed to this corporation free of incumbrances. These lands are conservatively valued at $250.000. The Norfolk-Portland Cement Corporation will create a mortgage of $500.000 to secure $300.000 bonds, which will be issued at once, and $200.000 bonds, which will be reserved for the additions which it is believed will become necessary before the plant has been in operation very long. There will also be an issue of $350.000 preferred stock and $500.000 common stock. The bonds will be guaranteed for principal and interest by the American Cement Company, which has been paying dividends at the rate of from 6 to 8 per cent a year on $2.000.000 capital stock for the last ten years. They will run for twenty years, but there will be an annual sinking fund sufficient to retire them at or before maturity. The preferred stock will be entitled to 7 per cent dividends before any dividends are paid on the common stock, and will also be preferred in the distribution of assets, in the event of liquidation. The American Cement Company will, itself, subscribe to $100,000 preferred stock of the Virginia corporation, and will receive $300,000 common stock in payment for the lands to be conveyed.

It will therefore practically control the Virginia corporation, the output of which will be sold through the established selling agencies of the American Cement Company, and under its well-known brands.

The bulk of the securities of the Norfolk company will be taken in Philadelphia, where the American Cement Company has its headquarters, but it is understood that the preferred stock will not be fully allotted until after the citizens of Norfolk have been given an opportunity to subscribe to a limited amount.

* * *

Spokane, Wash.—Lehigh Valley Cement Company has awarded a contract to the Sylvester Engineering Company to construct a plant, capable of developing 10,000 horsepower, at Metaline, Wash., to cost between $300,000 and $350,000. The plant will develop the power in Sullivan lake and Sullivan creek, and will be located at the confluence of the creek and the Pend Oreille river, above Metaline Falls, where a cement factory, to cost $1,000,000, will also be constructed.

A 40-foot dam is to be built at the outlet of Sullivan lake, in which enough water will be stored to maintain an average flow during the dry season sufficient to develop 10,000 horsepower. Another dam will be built across Sullivan creek, three miles below the lake, and the water of the creek will be turned into a large rectangular flume 6 by 9 feet. This will carry the water three miles further downstream and discharge it into the power plant, where it will take a sheer drop of 450 feet. When this water reaches the cups on the big water wheel it will be traveling at the rate of 100 miles a minute—so fast, in fact, that the entire volume of water coming down the flume forces its way out and into the cups in the form of a jet less than three inches in diameter.

Not all of the 10,000 horsepower to be developed will be used by the cement plant, and the surplus will be sold to the mining companies in the Metaline district.

Mr. Sylvester has already started a crew of men to work making a road to Sullivan lake from the Pend Oreille river. The power plant is to be completed in ten months. Work on the construction of the cement plant has begun. It will have a capacity of 2,000 barrels a day.

The extension of the Idaho & Washington Northern will reach Iona early in November. The extension to Metaline will be made during the winter. The river is to be crossed at the Box canyon.

* * *

Crippled because of the lack of a sufficient number of laborers, the big Manheim plant of the Alpha Portland Cement company is now turning out but five car loads of cement a day instead of 15 cars as the company desires. Urgent messages were sent out by wire to labor agencies in Cincinnati and Pittsburg yesterday, calling for at least 50 common laborers to be dispatched to the plant as quickly as possible.

* * *

Austin, Tex.,—Commissioner Colquitt disagrees with the opinion of Assistant Attorney General Walthall, holding that a special rate can not be put in on cement for Galveston causeway construction, and moves that the commission approve the rate and make it effective. Mr. Walthall held that it would be discrimination against other Galveston contractors to permit the causeway contrac-

tors to enjoy a lower rate than the former pay. The Texas and Pacific and Trinity and Brazos Valley Railways asked for a rate of 8c per 100 pounds on cement, carloads, from Harry's and Eagle Ford to Galveston for causeway construction.

"The language quoted from the act passed by the Thirtieth Legislature clearly indicates that authority is still vested in the Railroad Commission to grant special rates to meet special conditions. Evidently, one of the special conditions influencing the management of the Texas and Pacific and Trinity and Brazos Valley Railway Companies to ask for approval of this special rate is the fact that this special rate is necessary in order to induce the builders of the causeway to use the cement manufactured in Texas, as against that manufactured in and shipped from Germany to the city of Galveston. It is a condition which this commission should meet, as I believe the law justifies it in doing, and no fine spun theoretical construction of the law should be allowed to destroy the right of a Texas manufacturer and a Texas railroad to meet foreign competition of this kind."

* * *

Slatington, Pa.—One of the largest freight trains ever moved on the Bangor & Portland division of the D. L. & W. railroad passed through Northampton county on the way to tidewater recently.

It consisted of 40 cars of cement and was shipped by the Atlas Portland Cement Company to tidewater for delivery to the Panama Canal. The mammoth train was moved by four locomotives, two drawing and two pushing.

The Atlas is making large shipments, having placed a standing order on August 1 for the Lehigh & New England railroad to receive 35 cars daily at Bath Junction.

Eight cement companies in the stretch from Nothampton to Martin's Creek, Pa., are now shipping 100 cars of cement daily on the Lehigh & New England railroad.

The Alpha Portland Cement Company, of this city, restored wages of workmen to the 1907 level this month. The increase took effect August 1. The Alpha increased quarry labor to $1.50 per day of 10 hours, which is 5 cents more per day than in 1907.

CONCRETE AND RUST POSSIBILITIES.

The effect of concrete in preventing the rusting of steel imbedded in it has been the subject of so much controversy that the light thrown on the matter by the electrolytic theory of corrosion is instructive. According to this theory, iron can pass into solution only when an equivalent amount of hydrogen passes from the ionic in the gaseous state, and if the hydrogen concentration is reduced the rusting of the iron will be diminished. This is achieved by adding a strong alkali to the water which is in contact with the steel. According to Dr. W. H. Walker, the caustic lime given off by Portland cement in setting and hardening has this action and iron or steel imbedded in concrete will not rust so long as this caustic lime is present. Unfortunately it is soluble in water, and it is therefore desirable to make the concrete containing steel reinforcement very dense since by so doing the protective properties. If the caustic lime is once dissolved out of the concrete the metal will surely rust, according to Dr. Walker. This theory is completely in accord with experience, which has shown that dense concrete will protect steel even when it was rusted before being embedded in the material, while in porous concrete steel will sometimes rust rapidly.

CRUSHED STONE SCREENINGS IN CONCRETE.

Will you kindly give me your opinion about using screenings of crushed stone in place of sand for concrete. I am advised that the Government has used these screenings in place of sand for some of its public buildings, and from my point of view it is much preferable to sand, assuming that the screenings are absolutely free from dirt. I should be very glad to have your opinion on this.

Yours very truly,
R. M. Booth.

(Probably the best summary of present views on this subject is given substantially as follows in Mr. Louis C. Sabin's "Cement and Concrete;" Crushes dust or screenings, especially limestone screenings, if not too fine, give high strength in mortar. In concrete the use with the broken stone of all of the screenings will diminish the percentage of voids in the aggregate and thus decrease the amount of mortar necessary. Mr. Sabin's experiments, using a moderate amount of fine material, do not confirm the theory that the stone become covered with moistened, floury dust, so that the mortar cannot be so readily brought in direct contact with the stone, and the theory that if the mortar does reach the stone it is made less rich by the dust, which acts as so much fine sand. In some cases, however, the very fine material should be screened out of broken stone even if added again as sand in the concrete, because it collects in certain parts of the bin or pile, giving some batches that are rich in mortar and others with an excess of stone. By screening out all stone finer than 1-8 in. and then adding it as sand in making the mortar a better and more nearly a uniform concrete is secured.—(Editor Engineering Record.)

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CEMENT AND ENGINEERING NEWS

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JOHN F. WALDRON - - - - Advertising Manager

CHICAGO, NOVEMBER, 1909.

THE NEXT CEMENT SHOW

Will be held at Chicago, February 18 to 26, 1910. Contracts for exhibition space closed to date, insure a larger and more varied display, than any previous cement exhibition held in this country; which is gratifying indeed. Chicago has now become the recognized center for this class of expositions, by reason of its location, as the greatest railway center in the country. The Coliseum, where this exposition is to be held, will embrace and display the entire advance made in the use of Portland cement during the year. Machinery in operation showing the use of labor saving devices for the fabrication of cement products, by skilled operators, including hand and power plants, suitable for both the smallest and largest producers of cement wares. The best and most progressive men from all parts of the country, engaged in the manufacture of cement, and cement machinery will be on hand, to illustrate, describe, and operate the various installations of machinery, etc., for the benefit of interested visitors. The cement shows held in this country have become the great trade marts for the sale of machinery and appliances used in the cement products industry, as well as for the exchange of ideas by practical men relating to the best and most economical methods in the use of cement to produce sound first class finished work. The National Cement Users' Association, which we all know as "the pioneer Association," are to unite with the Cement Products Exhibition Co., and are to conduct, and have full charge of the technical end of the Convention, where papers will be read and discussed on all matters relating to manufacture and use of cement; many of these papers will be illustrated by the use of lantern slides, and will form a most interesting feature of the show.

The National Cement Users' Association, include among its active members, the highest technical talent in the country, whose single aim and end has been to keep the entire cement industry within such fair and proper limitations, as will result in the production of sound first class work by prescribing the use of proper materials entering into all cement products, especially in plain and reinforced concrete structures; all of which is based upon exhaustive technical investigations, made possible by liberal grants of money by the United States Government for this purpose.

NEW 'L' TRACKS ON A CONCRETE BED.

Preliminary designs for the elevated sections of the proposed new subway have been approved by the Municipal Art Commission of New York. The plans finally adopted will go again before the Art Commission for consideration.

Many improvements over existing structures are shown. Perhaps the greatest is the noise deadening plan, which the Public Service Commission has decided to make a feature of all future elevated roads.

A solid concrete floor from eleven to fifteen inches thick will be laid on top of the steel structures, and over that will be the ties supporting the rails and ballasts, which will probably be of the broken stone variety. The concrete flooring will weld together the steel girders and prevent noise from vibration caused by the operation of trains. No wood will be used.

THE LARGEST STONE CRUSHER IN THE WORLD.

Mr. Sheldon Stearns, New York manager of Power and Mining Machinery Company of Cudahy, Wis., recently sold to the Schuylkill Stone Company of Philadelphia, Pa., for installation at their quarries at Birdsboro, Pa., the largest crusher that has ever been built in the world. This machine is capable of receiving a piece of rock 5 ft. thick by 7 ft. long and reducing to 10 in. in one operation. Besides this large crusher they have sold them a complete outfit of auxiliary machinery consisting of large screens and pan conveyors; in fact everything for a complete plant. The approximate price for the machinery including installation is in the neighborhood of $75,000.00.

CEMENT PRODUCTS EXHIBITION.

At the drawing for space at the Third Annual Cement Show, Chicago, February 18-24, 1910, which took place on October 29, in the offices of the Cement Products Exhibition Co., 115 Adams Street, Chicago, the entire main floor and Annex space in the big Coliseum was taken and over 30 concerns were unable to secure space at all. This is the only instance where the entire available exhibition space has ever been taken so far in advance of the time of the show. This condition points to the widespread interest in the show and indicates that from the exhibitors' standpoint the Chicago exhibition has become exceedingly popular, and on account of the heavy demand for display space the Cement Products Exhibition Co., announces that room will be made in the second floor of the Annex and in the balcony to accommodate those who want to be represented with exhibits.

SWELLING, GELATINATION, ADSORPTION, COAGULATION.

By Dr. W. Michaelis, Sr.

As I frequently find erroneous conceptions to exist in the cement literature with regard to the phenomena accompanying the swelling of bodies and related physical

features, it appears advisable to me to make clear the fundamental principles underlying this branch of science.

There is hardly one person in a thousand who rightly conceives the term "swelling." The reason for this is that, in observing this process, invariably the solid or swelling body alone is taken into account, but not the whole system.

In discussing the phenomena of swelling, however, the medium causing the swelling has likewise to be considered.

Which medium causes swelling of a given substance depends upon physical or chemical conditions so far not thoroughly ascertained.

Owing to the one-sided view point above mentioned these processses are quite naturally considered to be accompanied by an increase of volume, whereas they are in fact exothermic processes of condensation; in other words during the processes of swelling, gelatination, adsorption and coagulation heat is liberated and a product is formed which occupies a smaller space than the volume of the solid or of the swelling or gelatinizing or adsorbed body plus the volume of the swelling or dispersing medium.

Colloids are micro-heterogeneous systems in which the phases (solid, liquid or gaseous) possess an extraordinarily large development of their surfaces and consequently touch one another in convex planes. The various phases are distributed in such a way that the system as a whole appears to be homogeneous. They are also called dispersed systems consisting of the dispersoid and the dispersing medium; both may be solid, liquid or gaseous.

The most important dispersoids in question are two-phased and the most frequent possibilities are liquid plus solid (suspensoids); liquid plus liquid (emulsoids); liquid plus gaseous (foams).

For the study of the chemistry of colloids I recommend the "Outlines of The Chemistry of Colloids by Wo. Ostwald. Dresden 1909. Published by Theodore Steinkopff."

Swelling may be defined as the ability of a solid body of assuming, in contact with a proper liquid, the state of a jelly, or as the capability of a substance to change its properties so as to become finally a jelly.

Gelatination means formation of emulsions, formation of emulsoidal systems of a higher order, in which the jelly is formed by two liquids which themselves represent emulsoids. Jellies are highly concentrated emulsoids. In gelatination the change of the original state consists in a decrease of the degree of dispersion, whereby the homogeneous arrangement of the phases remains the same, namely liquid plus liquid.

With increased gelatination density and internal friction grow steadily. Stability of form and elasticity characterize the jellies.

Adsorption is the densification of the dispersing phase of a colloidal solution (but also of a molecular-dispersed solution) on the surface of a solid, liquid or gaseous body, whereby the homogeneity of the dispersing system is disturbed by taking away a part of the dispersing phase from the dispersing solution. Adsorption-compounds can also be formed by dispersing systems, whereby the absorbing and the absorbed system are dispersed colloidal solutions, hence whereby mutual adsorption of colloids takes place.

Coagulation of colloidal systems is a decrease of the degree of dispersion coupled with the abandoning of the homogeneousness of the distribution. Coagulation leads in many instances to macro-heterogeneous systems; it, therefore, may be regarded as a visible (exterior) change of the physical state of a system in distinction from the invisible (interior) change of state, namely gelatination and swelling. The terms precipitation, formation of gel, formation of a flocculent precipitate are synonymous with coagulation. Gelatination and coagulation differ in as much as during coagulation, in contrast to gelatination, homogeneousness is abandoned and mostly a considerable change takes place with the dispersing phase through the disappearance of the dispersing medium.

It must be borne in mind that all these processes create hydrogels; in the case of adsorption, however, only if colloidal systems come in question.

Time and again I read the opinion published that I explained the hardening of the hydraulic cements by a process of swelling, whereas every attentive reader of my papers will find that, on the contrary, I taught that the hardening is brought on by the shrinking, by the solidification of the hydrogel. If carpenter's glue swells it does not bind. But, if the glue, formerly swelled by the boiling process, shrinks upon drying out, it binds and cements. With the exception of Dr. W. Michaelis Jr. and myself, no one has so far attributed the hardening to anything but a process of crystallization or has succeeded in explaining what renders the hydraulic mortar impervious to water. Alone my son and I have demonstrated that the hardening is chiefly and under water only effected by the drying out of the hydrogels which form in the course of the hardening process. These hydrogels originate by swelling, gelatination, coagulation and adsorption, and they dry out in time through the absorption of their water by the cores of the cement grains which remained unaffected in the early stages of the setting and hardening process.

FINENESS TESTS ON 200 MESH SIEVE VARY.

The value of fine grinding in Portland cement is generally recognized. The higher the percent through the 200 mesh sieve, the other tests being O. K. the greater the strength of the concrete.

As well as this fact is established there have been such different results on the 200 mesh test for the same car load shipments when made by competent testers, that the subject of fineness has perplexed the user.

The standard specifications for the 200 mesh test are plain. It is unfortunate, however, in order to comply strictly it should require so much time. In order to facilitate matters different methods are used, some testers use shot, some use a brush, others use a cover and bottom and shake rapidly but gently against a leather pad or soft wood until there is no more shown on a sheet of white paper in a few rapid shakings. The latter seems to be used the most.

Recently in order to find out what variation there would be in this test a sample was taken from a bin containing 20,000 bbls. This sample was divided into a number of parts and put up so as to insure its arrival at destination in good shape.

They were sent to recognized testers who doubtle[ss] are among the best in the country. A letter stating the

purpose was also sent to each and the greatest care was taken to make the test mean something.

Twelve reports out of fifteen were received promptly. They are as follows:

No. 1—85.8, Riehle U. S. Standard.
No. 2—86.0, Riehle U. S. Standard.
No. 3—86.2, Riehle U. S. Standard.
No. 4—86.54, Riehle U. S. Standard.
No. 5—84.2, Riehle U. S. Standard.
No. 6—86.6, Howard-Morse Standard.
No. 7—86.8, Howard-Morse Standard.
No. 8—85.8, Riehle U. S. Standard.
No. 9—83.3, Riehle U. S. Standard.
No.10—84.1, Riehle U. S. Standard.
No.11—83.8, Riehle U. S. Standard.
No.12—84.0, Riehle U. S. Standard.

What is the fineness of this bin of cement? The average of all tests would be 85.26. The majority vote would be 86.0. In one city it would be 83.3 while in another city in the same state it would be 86.0.

Each tester, no doubt would vouch for his sieve being in good shape and yet practically all the sieves are the same make. We know there is some difference in sieves, also we know there is some difference which we attribute to "personal factor" but both these should not make so great a difference as 83.3—86.8.

It would be well if tests on 200 mesh would agree within 1 per cent. The attention that is being given to it will soon require it.—(Geo. J. Trombold, chief chemist, Ash Grove Lime & Portland Cement Co., Chanute, Kans.)

REINFORCED CONCRETE.

At the summer meeting of the Institution of Mechanical Engineers, which was held recently in the municipal technical school, Liverpool, Mr. Arthur C. Auden read a paper on reinforced concrete. The author said that reinforced concrete had entirely passed out of the experimental stage, failures through bad design or workmanship being singularly small in comparison with the total amount of work done. Indeed, the reinforced concrete scrapheap was the smallest in any material with which engineers were familiar.

There were many systems dealing with the forms and methods of reinforcement, but no one system had the monopoly, different methods being the best for particular applications. It would be recognized, however, that any methods involving loose pieces, or pieces fastened together at many points with small diameter wires, were not so efficient in actual work as those where all the parts were rigidly fastened together. For the reinforcement of struts and columns, two very distinct methods were in use, one being that in which the vertical bars were prevented from spreading by being spirally wound with rods or wire, and the other where the same end was obtained by means of rings or loops of wire tying the vertical bars together. The spiral winding had given excellent results, and was considered by many engineers to be the best for columns, permitting the use of lighter and fewer vertical rods. There was the disadvantage, however, arising from the difficulty of making a good mechanical job with this winding. The second method of column and strut reinforcement had also given excellent results, particularly in cases where the loops were carefully made mechanically on hard metal formers, so that each one was an exact replica of its neighbor. With regard to the recent employment of reinforced concrete, reference might be made to railway sleepers, which were now being made in reinforced concrete to a large extent. Only experience could determine whether the longer life of such a sleeper as compared with the wooden sleeper compensated for the extra cost, but the results of six years' experience of the reinforced concrete sleeper under heavy traffic went to show that there had been no appreciable wear during that period.

RELATIVE STRENGTH OF CONCRETE.

It is ordinarily assumed, at least by the inexperienced, that the strength of concrete is measured by the proportion of cement in a given mixture relatively to the amount of the other materials—sand and stone. But the fallacy of this assumption is shown by the fact that the total volume of concrete is always less than the sum of the volumes of its ingredients. This is due to the ability of the smaller particles—the cement in a semi-liquid condition and the fine sand—to fill all interstices or "voids" between the larger pieces of stone. More compact concrete can be secured by the use of gravel than broken stone—the angular pieces of the latter frequently arch together allowing voids to form beneath. In a technical yet very practical way this subject is discussed in a recent paper by Mr. Leonard C. Wason, president of the Aberthaw Construction Company, Boston, Mass. He shows that for water-tight work gravel is always to be preferred as compared with broken stone.

There is little difference in strength between concrete made by broken stone or by gravel. Mr. Wason has proved by actual test that broken stone having a rough surface with angular fractures will give an increase in strength over rough bank gravel of about 15 per cent in most cases. In some, however, the gravel has given the greatest strength. This is always true if the stone has a glossy surface such as is found in some trap rocks.

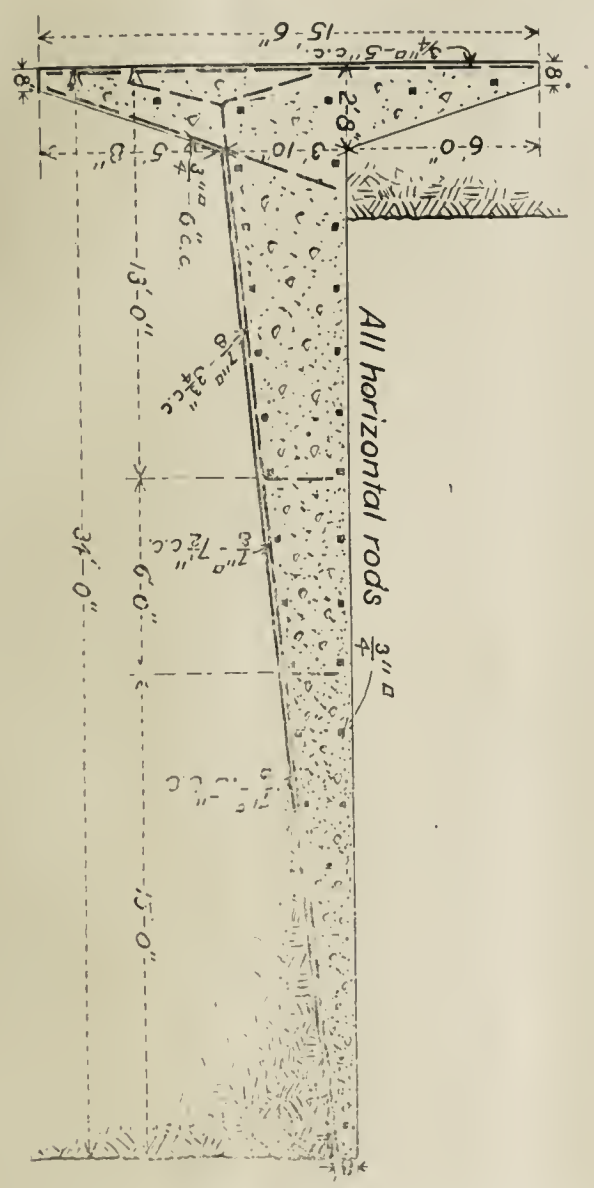
In the first instance if the specifications required one-three-six broken stone concrete, and there is a difference in cost between broken stone and gravel screenings of two cents per cubic foot, it will be cheaper to use a mixture of one-two and one half-five with gravel and still obtain an equal strength with the broken stone. Mr. Wason makes the rule never to allow the size of stone in its greatest dimensions to be more than half the thickness of the work into which the concrete is to be placed. In large size work, very much larger stone can be used than is ordinarily done with very good results, the only limitation being that of convenience in handling. In regard to placing it is much easier to obtain dense concrete, that is, without voids, using gravel than using broken stone, as angular pieces will sometimes arch together, allowing a void to form underneath. Therefore, for water-tight work gravel is to be preferred every time. For nearly all classes of work the best results will be obtained by using such an amount of water that the concrete when placed will just barely quake, but is not sufficiently soft to flow.

The Steel Protected Concrete Co., Philadelphia, Pa., have recently issued a pamphlet describing the construction and merits of steel bound concrete curb and one pamphlet of unusual value giving full detailed directions for constructing such curb. The last pamphlet is one worth keeping permanently on file. The company also has a desk ruler and paper weight souvenir which will be mailed free to interested engineers.

THE BONE RETAINING WALL.

The Bone System of Retaining Wall constructed by the Concrete Steel-Retaining Wall Co. of Cincinnati,O., is a reinforced concrete structure, so arranged that the weight of the retained material acts as a force to keep the wall in an upright position.

A heel is extended to the rear of the wall. The earth fill rests upon this heel, and the wall can not overturn without lifting the earth above the heel. Thus the weight of the retainer material itself keeps the wall in



Wall erected by the Pennsylvania Railroad Company at Torrence Road Station, Cincinnati, O. The bank behind this wall is joint clay, and when wet takes quite a flat angle of repose, thus bringing an uncommonly heavy load on the wall.

its normal position. The earth on the heel can be considered an integral part of the structure, the materials of construction of which are concrete, steel and earth, the concrete steel part simply serving as a casing to keep the earth part in shape.

A toe can be extended to the front of the wall. This produces a longer leverage, giving the wall a greater resistance to overturning, and also distributes the pressure on the foundation.

The rupture of the wall itself is prevented by the reinforced concrete construction. Sufficient area of steel and concrete are used in the proper places to resist, respectively, tension, compression and shear.

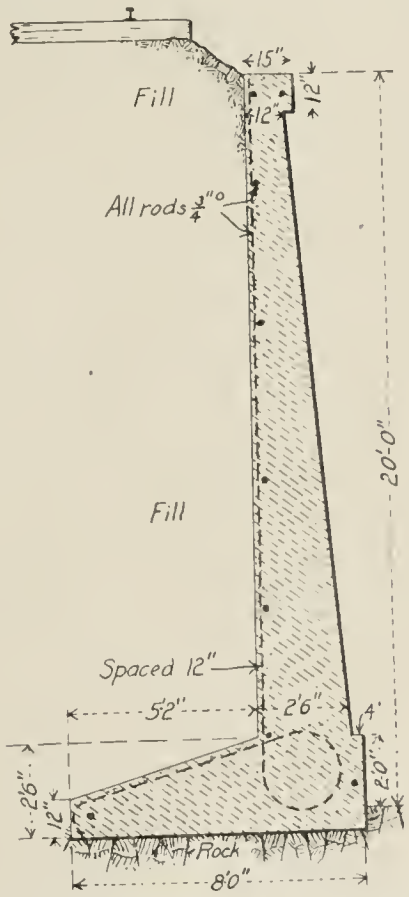
The economy of a retaining wall, which makes use of earth to give it weight in place of concrete is readily seen. There is an old proverb which says something about "as cheap as dirt." This applies literally to the Bone wall. The extra cost of the steel which must be used to reinforce the concrete is small, compared with the gain. The forms for walls of the types shown herewith actually cost less than for a gravity or solid concrete wall of the same height.

C. F. Graff, C.E., of the Great Northern Railway Co made a series of calculations as to the saving that can be obtained by using reinforced walls as compared with plain concrete walls of the same stability, with the following results:

For wall 40 ft. high, saving 45 - per cent.
For wall 30 ft. high, saving 43.3 per cent.
For wall 20 ft. high, saving 36.4 per cent.
For wall 10 ft. high, saving 20.4 per cent.

We give in our pamphlet several designs comparing the amount of material used in our wall with that used in a plain wall; also, examples of actual bids taken, and refer here to bids received for construction of the abutments and wing walls of the Reed Avenue Viaduct, at Columbus, O., in spring of 1906, in competition with a gravity wall of sandstone and concrete. Both plans were of the same height, length and capacity. The bid of Jones Bros. was $51,929.50 for a gravity wall and $32,695 for a reinforced wall, the gravity wall being 58 per cent more than the reinforced. Other bidders made a large difference, Westwater & Casey making 39.5 per cent, F. M. Townsend 36.8 per cent and Strum & Co. 39.5 per cent. The bids for reinforced wall included an item of $3,000 for royalty, so that the bids showed the net economy of the reinforced wall.

There may be those who do not care for expense, and do not care to consider a more economical system. In the case of retaining walls this is an unwise position.



Section of a wall, of which 1,300 lineal feet were erected along the Great Miami River during 1906, by the Cincinnati Northern Traction Company.

Earth thrusts acting against retaining walls are very uncertain and variable, depending upon many conditions. No engineer can calculate or tell what the pressure against a wall is going to be. It may be slight or it may be great, taxing the wall to the point of failure. It is good practice then to put the money and material to the best possible advantage by using the form of construction of the highest efficiency. Good engineering, ability and judgment could certainly not do otherwise.

A better and more scientific wall can be made of reinforced concrete than is possible with plain concrete or stone masonry.

By the use of a broad base and a reinforced toe extending to the front of the wall to distribute the pressure on the foundation bed, the unit pressure can be

kept well within the limits of the bearing power of the particular kind of earth on which the wall is built. Such a flexibility of design is not possible with a gravity wall of solid masonry. It is not such a problem in retaining wall construction to obtain sufficient weight for stability as it is to get a suitable foundation bed to sustain this weight. Nearly all of the failures of retaining walls are due to the settlement of the earth under the toe, caused by the excessive pressure at this point. Authorities (See Baker's Treatise on Masonry Construction) state that from 90 per cent to 99 per cent of the failures of retaining walls are caused in this way. In gravity walls it is often necessary to use expensive piling. This expense can usually be dispensed with in a reinforced wall by the use of the extended toe.

Many kinds of earth, which must be used for foundations, will settle some when the load is put upon them. In most structures, as in buildings, this settlement presents no serious difficulty, as it is uniform and lets the structure down evenly. In such cases settlements of several inches or a foot can and have been allowed for. But in gravity retaining walls the greatest pressure, and, consequently, the greatest settlement, being under the toe. the wall is thrown out of plumb, moving the center of gravity further forward, and bringing still more pressure under the toe, causing more settlement, and so on. In the reinforced concrete wall the toe can be so extended as to cause the resultant pressure to strike the base in the middle. This is an ideal condition, and produces a uniform pressure all along the base, resulting in a uniform settlement. The face of the wall will therefore remain vertical.

In designing a gravity wall the resultant pressure must be made to strike the base within the middle third to avoid tensible stresses in the back. But in the reinforced wall this tension is provided for by the reinforced heel acting as a cantilever beam and so the resultant is not limited to the middle third, but may strike out near the end of the toe, when on solid foundation. Gravity walls of solid concrete may be able to resist some tensile stresses in the back, but it is not good practice to depend upon concrete to resist tension. If longitudinal cracks or cracks having longitudinal components should occur in the back of the wall, its ability to resist tension would be destroyed. If in construction, the concreting was ever stopped long enough between the laying of two consecutive courses, a weak joint would result. A gravity wall then, even if built on a solid rock foundation, can only be considered safe when the resultant strikes within the middle third, while a reinforced concrete wall, on the same foundation, will be absolutely safe in this respect until the resultant strikes out practically at the toe.

An important advantage of these thin walls is that they need only from one-half to one-fourth as much longitudinal reinforcing metal as ordinary walls of same stability to make them safe against vertical cracks caused by shrinkage or temperature stresses that usually occur in plain concrete walls that are more than 30 or 40 feet long.

One of the most disastrous agents to be contended with in ordinary walls is freezing. The earth back of the wall, unless excellently drained, is liable to be saturated with water, which expands upon freezing. The force which this expansion produces is irresistible, and the wall, no matter how substantial, is forced outward slightly. This displacement of the wall may not be noticeable for a time, but after many seasons of frost, each one of which adds its increment to the displacement, the wall will begin to lean or to shear off at the top, and eventually to fail. A reinforced wall of the inverted T type is able to stand, without damage, a pressure due to freezing, without rupture or permanent displacement, because the elasticity of the cantilever beam forming the vertical part of the wall will allow it to give considerably and then return to its original position as soon as the force is removed. The frost breaks the earth up into a very mellow condition, and so it is easily compressed by the beam acting as a huge spring, when thawing takes place.

The frost pressure acts mostly at the top of the wall, and, fortunately, practically all of the deflection of the concrete steel wall under this pressure is at the top, the place where the greatest displacement is needed. This is explained by the tapering of the beam and the distribution of the reinforcement. According to the primary design to account for the earth thrust, the quantity of steel is so distributed that the unit stress will be nearly the same at all points up the wall. So the unit elongation on the tension side will be the same at all points. But the neutral axis comes nearer the rods toward the top, making the radius of curvature shorter. Therefore, the curvature is greater at the top, and the horizontal deflection much more than at points a little distance down. Now this is the deflection caused by the earth thrust. But the moment caused by the earth thrust varies as the cube of the distance from the top, while the moment by the frost acting at the top varies directly as the distance from the top. So when the wall is under a moment caused by frost the unit stress, and consequently elongation, are much less toward the bottom of the wall, and the difference between the two curvatures at the top and bottom is much greater than it is even when produced by earth thrust. So it may be seen that when the frost deflects the wall at the top the displacement will be practically nothing further down on the wall, giving the earth no room to drop down and keep the wall from coming back.

There is no serious objection to the deflection of the wall under earth thrust, as this can be provided for the same as the linear expansion of walls and bridges, due to shrinkage or temperature changes.

COMPARISON OF TYPES.

The wall having an inverted T-shaped cross section has all of the advantages mentioned above. It is simple to construct, the rods being easily placed and its forms costing no more than those for a gravity wall of the same height.

The wall having an L-shaped cross section is adapted to places where the property line or other reasons will not permit a toe. It has not the advantage of uniform settlement on soft foundation beds to such an extent as a T wall, and requires a little more material in the base.

A wall with counterforts, with the use of a little more steel, can be made with less concrete than any other type. However, the net cost is usually more than it would be for a T wall on account of the complexity of the forms and the network or rods which must be put in place and kept in place, often making the placing of the concrete difficult and slow. The forms alone sometimes cost as much as the concrete placed in them. It is hard to determine the correct positions of the stresses under the various loads, even with the most careful method or design. Neither does the counterfort wall have the great advantage over the gravity wall which the T and L walls have with regard to the allowance for freezing.

BUILDING THE NEW RESERVOIR FOR NEW YORK'S WATER SUPPLY.

A large party of engineers is now engaged in making surveys for the creation of an artificial lake thirteen miles long and an average of two miles wide and 240 feet deep at the greatest depth in the valley of the Esopus Creek, in the Catskill Mountains, sixteen miles west of Kingston, in Ulster county, New York. This lake is intended to store water from the melting snows and from ten thousand mountain springs for the use of the City of New York. The area of watershed is over 900 square miles, and it is capable of furnishing 800,000,000 gallons daily, which will be carried 130 miles in an aqueduct to Battery Park, New York, and twenty miles farther to the limits to Greater New York, at the southern extremity to Staten Island. The aqueduct is now under construction, and will cross the narrowest place in the Hudson river, from Cornwall to Cold Spring, through a concrete siphon thirteen feet in diameter, 600 feet below the bottom. The tunnel will be large enough to accommodate a train of Pullman sleepers—almost as large as the new tunnels of the Pennsylvania Railroad betweeen Jersey City and New York. The entire cost of the undertaking is estimated at $162.000.000, and the contracts, which are nearly all let, and, in several cases, were undertaken several months ago, representing an expenditure of over $150.-000.000.

The aqueduct will run parallel with the Hudson river as far almost as West Point on the west side, then from Cold Spring, on the east bank, southward to a great distributing reservoir near Yonkers. It is expected that the present system of distribution will be sufficient for the next twenty years, but it is estimated that by the year 1930 the population of Greater New York will be upward of seven millions, who will consume one hundred billion gallons of water daily, which will require an additional distribution system at an estimated cost of $40,000,000.

At the present rate of progress, it is expected that the reservoir and aqueduct will be completed by the year 1915—about the same time as the Panama Canal—and in some respects it is a greater and more difficult undertaking.

The creation of this reservoir will obliterate seven towns and about a thousand farms, whose inhabitants have sold their property to the water commissioners of the City of New York, and are now removing to other parts of the state to seek new homes. A large number have settled in Kingston, which, at the next census, will show an unprecedented increase in population. About ten thousand people will be compelled to move before water begins to accumulate in the reservoir, and about 100,000 summer boarders will have to look for new places next season.

The City of New York now has two sources of water supply. The Croton water works, built between 1836 and 1842, at a cost of $14,000,000, which was the greatest undertaking since the Roman aqueduct, brought the first supply of water from a little stream about ten miles in length which flows into the Hudson at Croton Point, on Haverstraw Bay.

In May, 1837, a dam was constructed across that little river in the hills, six miles from its mouth, and a lake was produced almost six miles long, capable of containing 500.000.000 gallons. The first dam was swept away by a flood, and had to be rebuilt. The second dam proved to be secure, and an aqueduct running parallel with the Hudson at an average distance of half a mile from its east shore has carried from 40,000.000 to 50 000.0000 gallons of water to the city every day for nearly seventy years. The tunnel is of brick, and may be traced by white stone ventilating towers all the way from the lake to the beautiful High Bridge, which carries the water over the Harlem river.

When the growth of New York required an additional water supply, a second aqueduct was constructed in 1884, in an almost perfectly straight line through the solid rock at an average of 500 feet below the surface. This tunnel is thirty miles long, fourteen feet in diameter, delivers 300,000,000 gallons of water from a cluster of lakes every twenty-four hours, and cost $25,000,000.

In 1905 the municipal officials of New York City went to the legislature at Albany and secured the passage of an act authorizing the mayor to appoint a board to provide an additional water supply to meet the increasing demands of the metropolis. J. Edward Simmons, Charles M. Chadwick and Charles A. Shaw were appointed. Mr. Simmons resigned after a year of service, and John A. Benzel was appointed to succeed him. These gentlemen, having made a thorough investigation, reported in favor of a reservoir in the Esopus Valley. In the meantime, the legislature passed another act appointing a state board of supply to make a general investigation of the water resources of New York, to recommend measures for their conservation, and providing that no municipality should help itself to any water outside of its own limits without the approval of this board, ratified by the legislature. The plans of the New York board were submitted according to this law in 1907 and were approved. The same year another act passed authorizing them to take the necessary steps to acquire land by condemnation, to build an aqueduct, and authorized the issue of bonds sufficient to pay the expense.

Since that date Kingston has been the scene of unprecedented activity, and every available building and office room has been occupied by the board of water supply and its staff of assistants. Appraisers have followed the engineers from house to house through the valley that is destined to be the bottom of a little lake, negotiating for the purchase of land and the payment of indemnity for houses, stores, churches, schoolhouses, barns, stables, quarries, factories, gardens, farms and orchards, for everything of value within the area or the proposed lake has to be bought and paid for at the price fixed by a board of appraisers and approved by the courts.

There have been ten different commissions at work since 1907, and they have nearly completed their tasks. They tell me it has been the most rapid, successful and harmonious proceeding of the kind that has ever been undertaken, and that the largest part of the property involved has been purchased by direct negotiations between the representative of the water supply board and the owners without appeal to arbitrators or to the court In the remaining cases the appraisers submitted their estimates to the commissions, the owners brought in expert witnesses to sustain their judgment as to the value of the property, and the commissions fixed the amount of damages. If the owner is dissatisfied he has an appeal to the courts, but there have been very few appeals.

The Ulster and Delaware Railroad is the heaviest sufferer, and will have to remove sixteen miles of track to a new route. Seven towns will be entirely obliterated, as follows: West Hurley, 264 population; Olive Branch, 150; Olive City, 556; Shokan, 446; Glenford, 642; Broadhead Bridge, 150; Bolceville, 190. In addition to these villages there are about 1.000 farms, varying from 20 to 150 acres, with residences, out-buildings, orchards, hen-houses, and every other feature of a well-ordered farm, all of which will have to be paid for.

Nearly all of the farmers are accustomed to take summer boarders, and between the 1st of June and the 1st of October it is estimated that the population of that part of the valley affected by the water works is increased from a normal 10 000 to 100,000. There are ten churches to be paid for, forty schoolhouses and twenty cemeteries, from which the bodies must be removed at the expense of New York at an average cost of $25 each. There are several grist mills, saw mills and various manufacturing industries with small capital; numerous stone quarries, hundreds of mercantile establishments, and telephone and telegraph lines.

This is the land of Rip Van Winkle. The villages to be destroyed were settled in the latter part of the seventeenth and the early part of the eighteenth centuries by English immigrants. A majority of the farms are still owned by the descendants of the original settlers, and the land commissioners tell me that they have been surprised at the number of original Indian deeds that were turned in. The settlers first engaged in lumbering and tanning, and when the timber was cut away they opened quarries of blue flagstone, which is now shipped from Kingston to New York City and other points in enormous quantities. The sidewalks of many cities came from this valley, and there are massive beds of a magnesian limestone, from which Portland cement is made. At least 3,000 men are employed in blasting out, crushing and grinding it into powder, and not less than 3,000,000 barrels are shipped annually from Kingston to all parts of the country, where it is required for all masonry exposed to water, and is the principal constituent of concrete.

The people are abandoning their homes with great reluctance, but are being well paid, and most of them are satisfied. The average payment has been $3 000, and the entire amount disbursed for the land required for the reservoir will be nearly $80,000,000. The owners are getting their cash now. The paymaster is here at Kingston, and a constant procession is going to and coming from his office, carrying checks of all sizes, from $50 to $10,000.

The dam will be 1,400 feet long, 240 feet high and 30 feet thick, and it will be built of stone and concrete. While it is being built the owners of the property will have three or four years' time to move their families and effects, and will be allowed to carry away everything that is portable. Then the water board will sell at auction whatever is left to the highest bidder.

A driveway or boulevard thirty feet wide will be constructed around the shore of the new lake, and it will be about forty miles long, connecting with the new state road now being constructed from Hoboken and Englewood in New Jersey on the west bank of the Hudson, north to Albany. It will also connect with the present road from Kingston to Cooperstown and Binghamton.

REINFORCED CONCRETE TESTS.

The increasing use of reinforced concrete as a building material has led to numerous investigations of its strength when variously prepared, and when subjected to various conditions. Perhaps the most elaborate series of tests is that now being carried on by the United States Geological Survey, which has recently published (Bulletin 344) a preliminary report on the subject. A full report, with a thorough analysis of the results, will be published after the 52-week tests are completed.

The attempt has been made to bring out the comparative value of gravel, granite, limestone and cinders for use in concrete, and the effect of age and consistency on the strength and on the stiffness.

No attempt has been made in this preliminary report, however, to generalize the results of the tests, or to draw any conclusions, however warranted they may appear from an examination of the test data. It is hoped that the matter presented will provoke discussion, and in order to promote this end, extended expressions of opinion or attempted applications of theory to results have been avoided. A running commentary on the results of the tests, however, emphasizing matters of particular interest and indicating a few points that might lead to interesting analyses, is included.

The bulletin, which is by Richard L. Humphrey, may be had free of charge on application to the Director, United States Geological Survey, Washington, D. C.

CONCRETE SEWERS PREFERRED.

In letting the contract for all the work on the West Denver (Colo.) storm sewer to Gaffy & Keefe the board of public works took an important step. The contract price is $66,900. This is not so big but the contractors will use concrete pipe. This is considered the important point at city hall—the use of concrete in sewer work giving what the charter calls for in public work, namely, competition. Vitrified brick pipe has been used heretofore, and while it has served the purpose well, the price has been considered high on account of lack of competition. With the cement companies bidding on this class of work the taxpayers will get the benefit. The battle will end in the survival of the fittest, and in the meantime there will be a reduction in prices all around.

In the contract which is about to be awarded for the West Denver sewer a 24-inch concrete pipe laid in the ditch will cost $1.03 a foot. Under the old order vitrified pipe of this size cost $1.37½ on the bank, to which have to be added the cost of trench digging. A 21-inch concrete pipe costs 87½ cents in the ditch, whereas a vitrified brick pipe cost $1.10 on the bank.

The molds and equipment for making the cement pipe on this job and on most of the important jobs throughout the country are being furnished by Miracle Pressed Stone Co., Minneapolis, Minn.

The mayor and board of public works have had this question of concrete versus vitrified clay under discussion all summer and spring. The vitrified brick people have made a hard fight against the introduction of concrete, and they started agitations against its use in certain parts of the city. For a time they succeeded. Some small contracts let earlier in the year in which the contractor was expected to use concrete were finished with the old material by "arrangement" with the contractor and manufacturer, but in the West Denver job concrete will be used.—(Denver Republican.)

NEBRASKA CEMENT USERS TO MEET IN FEBRUARY.

The Nebraska Cement Users' Association will hold its annual convention February 1, 2, 3 and 4, 1910, at Lincoln, Neb. Every possible effort is being made to make this the most complete and successful convention yet held by this association. Peter Palmer, Oakland, Neb., the secretary, has sent out a list of questions to all concrete workers and manufacturers, and desires their co-operation by answering the same, for a more thorough acquaintance and general report of conditions.

BIG MANUFACTURERS OF ASPHALTIC MATERIALS INCREASE CAPACITY.

Business in all lines is gradually returning to the equilibrium from which it was so rudely "jolted" a couple of years ago. This renewal of activity is as marked as it is encouraging, and it may fairly be said that in almost every line of industrial endeavor the dominant note voices the spirit of uplift, and that if Prosperity has not returned, she is surely on the way.

As one instance among many which might be cited in proof of this, a striking example is offered in the recent movements of The American Asphaltum & Rubber Co., a Chicago industry whose operations practically ramify every state in the Union, while surplus energy is successfully carrying their product into foreign lands.

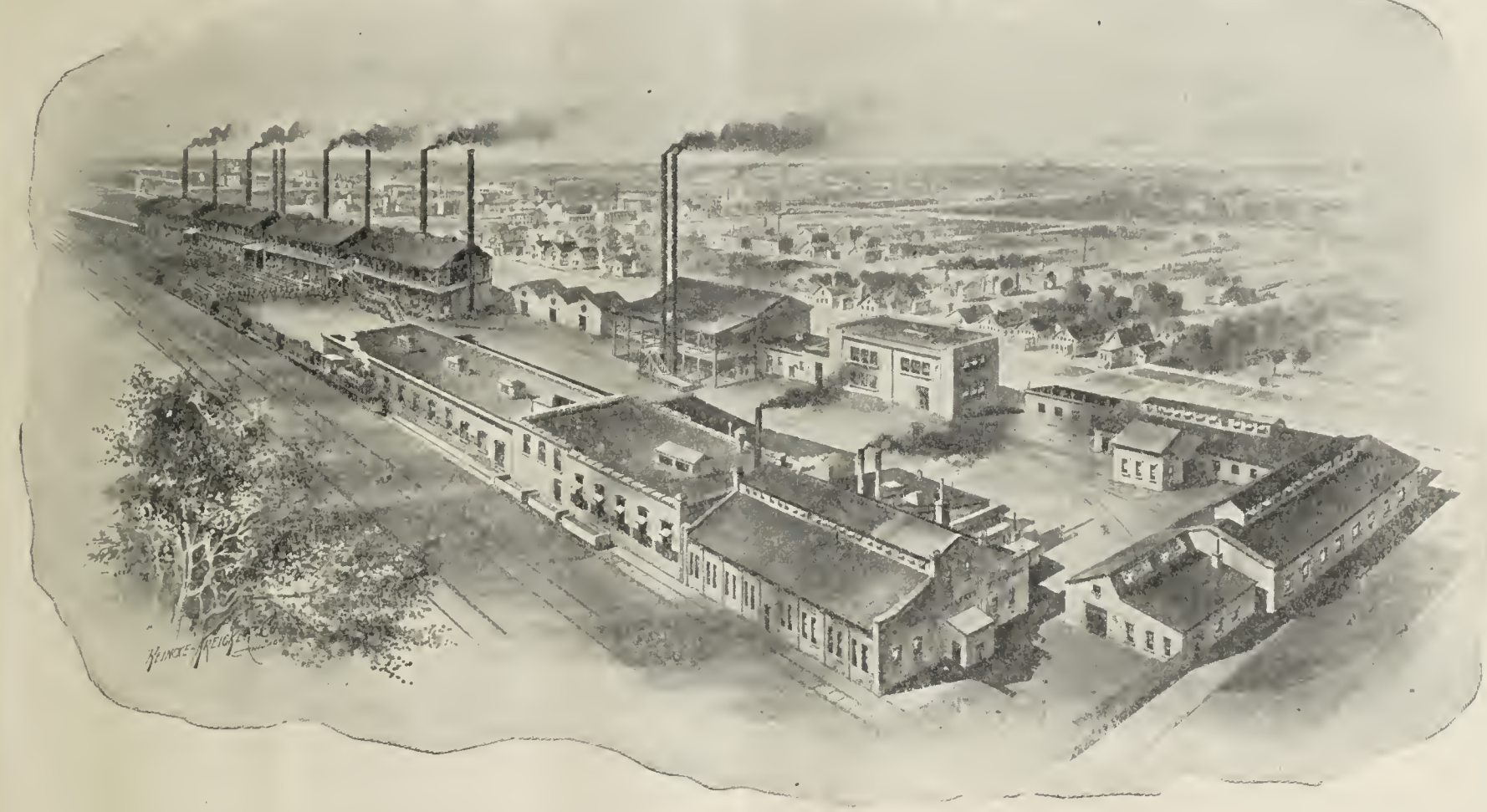
The present demand for the various materials manufactured by this Company is particularly strong, due perhaps to a combination of favorable circumstances. Conspicuous among these gratifying conditions is the fact that The American Asphaltum & Rubber Co. own and control the mines from which are obtained the basic constituents of their principal products. These mines are located in Utah; the hydro-carbons and Gilsonite they yield have long been noted for their superiority, and as equally high grade materials can scarcely be obtained elesewhere, the prestige of the owners of these mines (as manufacturers) is apparent. -Their structural and other paints, waterproofing asphalt, pipe coating, floor mastic, ready roofing and street paving asphalt are all firmly established staples, and for the past twelve years have been so recognized by engineers.

During the first half of the current year, trade indications—those substantial indications known as "contracts," "sales" and "orders"—pointed to the necessity of increased facilities, and, accordingly, the manufacturing plant was enlarged and its daily capacity increased by 200 tons.

The illustration herewith is a faithful birds-eye view of this plant and fully warrants the claim that The American Asphaltum & Rubber Co. are at least one of the largest producers of asphaltic materials in the world. The shops are modern and all equipment—machinery and devices in every department— the latest improved.

The Company has its own chemical laboratory, and constant watchful care is exercised for the maintenance of the high standards of its products.

The manufacturing plant is located at Grand Crossing, Ill., and the general offices occupy the greater part of the 6th floor of the Harvester Building, 234 Michigan Ave., Chicago. The officers of the Company are: J. F. Hill, Pres.; H. Rawstron, Vice Pres.; H. F. Bunde, Secretary & Treas. A. J. Hill is General Sales Manager.



PRIZES FOR INVESTIGATIONS OF CONCRETE.

Engineering Graduates of Ames Win Rewards.

The award of the Miracle Thesis Prizes for the competition of 1908-1909 has just been made. Mr. O. U. Miracle, of Minneapolis, Minn., a former Ames student, provides, annually, a sum of money to be awarded in three prizes for investigations helpful to the concrete industry.

Five Thesis, representing the work of nine men, were presented in competition for these prizes. Mr. Geo. P. Dieckmann, Chief Chemist of the Northwestern States Portland Cement Co., at Mason City, Iowa, Mr. L. L. Bingham, a prominent cement pipe, block and sidewalk manufacturer at Estherville, Iowa, and Professor I. A. Williams who has charge of the cement and clay work instruction at the Iowa State College at Ames, were the judges.

The first prize of $50 was awarded to Messrs. R. R. Strother of Hubbard and Platt Wilson of Montezuma, for an investigation of the Proper Proportions for Mortar Concrete.

The second prize of $30 was awarded to Messrs. O. L. Huffman of Wyoming, Iowa, and E. S. Fowler of Radcliffe, for an investigation of the Effect of Clay and

Reground Cement on the Permeability of Concrete and Cement Mortars.

The third prize of $20 was awarded to Mr. Royce Heath of Ames, for an investigation of Patent Compounds for Wateproofing Concrete.

All the investigations were considered by the judges to have brought points of importance to the concrete industry; and they will be published shortly in a bulletin of the Engineering Experiment Station at Ames, copies of which can be obtained free by writing to A. Marston, Ames, Iowa.

BONDING NEW CONCRETE TO OLD.

By Albert Moyer, Assoc. Am. Sec. C. E.

Clean off with clear water and stiff broom the surface of the old concrete. Mix 1 part commercial muriatic acid or Hydrocloric Acid and 3 parts water, or use Bonsit or Ransonite, mixed according to directions with hot water, make several applications one after another with a brush containing little or no metal. This will not injure the concrete as the acid does not sink to a sufficient depth before it is neutralized.

This will have the effect of removing the cement from the top surface of each grain of sand or piece of stone and the other aggregates that may have been used, exposing the clean surface of these aggregates in exactly the same condition as they were before being mixed.

After applying the acid wash the surface with clear water, scrubbing with a stiff broom or brush removing all the dead particles. While the surface is still wet (and it should be thoroughly wet) apply the new concrete. Protect this new concrete by keeping it damp for at least a week. Do not let it dry out at any time during the first week.

It will be found that the new concrete will bond to the old as strongly as if both had been mixed at the same time.

A NEW CONCRETE BLOCK.

A new form of concrete block, which is a marked departure from the ordinary product, is turned out by a new machine made by the Diamond Concrete Machinery Company, Chamber of Commerce, Chicago, Ill. This block is an interlocking, self-lining block which possesses many advantages in service and is labor-saving in erection.

The principal point of difference from the present standard concrete block is that they mortise into each other slightly at the ends, top and bottom, thus forming a solid interlocked wall. With this arrangement the first course is carefully laid straight and level and all courses above it are kept in line and maintained level by the grooves in the courses below. This permits of their being laid up by any intelligent workman. The mortar is retained in the hollow spaces and prevented from running down over the faces of the blocks, which saves the cost of cleaning off when the wall is completed. A space is left at the outside joints for tuck pointing, obviating the necessity of scraping out the joints before pointing, and thus saving a considerable part of this expense. The interlocking at the joints makes them very tight and the wall very solid. The holes in the the blocks come directly above each other, so a solid reinforced wall may be made if desired by placing steel rods in the shafts made by the holes, after the wall is laid up, and then filling the holes with poured concrete to bind the entire wall into a solid mass. In this case the blocks may be laid up very rapidly without mortar.

The machine which makes these blocks is a wet process, face-down machine. When the block is made it is turned one-fourth over, the cores being automatically withdrawn and the mold released from the block at the same single action of the lever. The pallets are made with handles to save the time of picking up and attaching a carrier. The molding box is closed and made ready by one action of the lever and the cores thrown into place by a foot lever. The face plates and end plates are interchangeable for different style of blocks. Attachments can be used to produce blocks 8 inches, 10 inches and 12 inches thick.

NEW BOOKS.

Portland Cement; by A. C. Davis, of Cambridge, England. Fellow of the Chemical Industry; Fellow of the Inst. of Directors, etc.

This is the second edition of Mr. Davis' book, revised and enlarged, 410 pages, three appendices, 150 illustrations published by Woodford, Fawcett & Co., 38 Southhampton St., Strand, London, England; price 15 shillings or $3.60. It is an up-to-date treatise on the manufacture of Portland cement and gives the most modern methods of testing raw material, and the finished product; illustrating and describing the machinery and apparatus employed, etc. While the book of course is written primarily from an English point of view, the author has also made a careful study and personal investigation of the German, French and American cement industries, and is a practical cement manufacturer of many years experience; also has had an extensive practice as consulting engineer for the Portland cement industry throughout Great Britain. Mr. Davis possesses unusual qualifications to deal with the subject on broad comprehensive lines, and at the same time, the most minute details are covered in every branch, and sub-branch, relating to the manufacture and testing of raw materials, and the finished product. Herbert Spencer, in his essay on literary style, says, "The best literary style is that which calls for the least mental effort or labor to grasp the author's meaning." We think that Mr. Davis possesses the rare faculty of making everything at once clear, which he discusses.

The treatise is equally valuable to the trained expert and the student desiring to familiarize himself with the technical details employed in the manufacture of sound Portland cement. The work is divided into 14 chapters, abstracts from which are as follows:

1—Definition and constitution. 2—Raw materials 3—Dry, wet, and semi dry and wet processes. 4—Estimating and analyzing raw materials; complete method of analysis in detailed calculations. 5—Burning, and calcining, explanations of chemical changes, temperatures, rotary kilns, product, fuel efficiency, heat, etc. 6—Clinkering and grinding machinery employed, chemical tests, value of same, etc. 7—Composition, minerology of cement, clinker rusting. 8—Sampling, testing, practical tests of cement by consumer, etc. 9—Fineness, sieving, British standard specifications, etc. 10—Tests for bushel weight and specific gravity. 11—Setting. Automatic cement setting recorder, etc. 12—Soundness, contraction, expansion, etc. 13—Tensile strength. 14—Compression and transverse tests. Factors effecting results of tests by compression; relations between transverse and tensile tests, etc.

There are three appendices, covering British standard specifications on cement and American specifications and methods of testing, etc.; standard methods of analyzing raw materials. Standard German specifica-

ons for Prussian Government works and French overnment specifications. United tables, material uivalent weights of building materials, etc. A comete list of cement plants in England and Wales, showg location of each plant marked in red. The author as made a thorough study of the rotary kiln to which devotes 55 pages of instructive matter, and which believes to be the kiln of the future; the cement proced being superior to that produced by the old dome d shaft kilns of the past.

We would advise our readers interested in the manucture and use of cement to secure a copy of this ork; it will be money well invested.

* * *

Beton Kalender for 1910.

The Beton Kalender, reference pocket book for reinorced concrete construction, 1910, has just been issued, volumes 840 pages, price $1.00, postage extra, published by Wilhelm Ernst & Sohn, Wilhelm Strasse 90, erlin W. 66. This is the fifth annual publication of the eton Kalender, which as usual contains a complete reiew of the state of the reinforced concrete industry, nowing the progress of same up to date, illustrated ith 1,107 cuts and diagrams, including illustrations nd descriptions of machinery, and appliances used in l branches of the industry. Volume 1 is cloth bound, nd vol. 2 paper covered. In our opinion this is the most mprehensive treatise on the subject of concrete conruction, that is published. The compilers seem to ave ransacked the earth for data on the subject. The ork gives in full the German specifications for the hemical and physical testing of Portland cement and s products. We advise our readers to send for these wo volumes, as the money will be well spent, the work eing a veritable engineers encyclopedia on all branches f the subject of plain and reinforced concrete.

* * *

"Modern Pulverizing Methods" is the title of a neat ooklet issued by the Pulverizing Engineering Company f Cape Girardeau, Mo., treating of the pulverizing and eparation of material in Portland cement manufacture. The booklet discusses the various classes of pulverizing achinery in common use, and the general problem of eparation, finally describing in detail the Perfection Air eparator manufactured by that company. In connecion with this matter several views of the separator are iven, showing its general construction, interior arrangenent and its place in the ordinary conveyor system.

* * *

Hendrick's Commercial Register.

The 18th annual edition of Hendrick's Commercial Register of the United States has just been publisht: t contains over 350,000 names and addresses of American manufacturers and contractors classifitd under 5,774 heading, representing about veery machine, maerial, apparatus or specialty required in the architectural ngineering, mecahnical, contracting manufacturing, ailroad, mining and quarrying industries. The heading indtr cement and concrete machinery, etc., present what ppears to be a very complete list of firms in these lines. The price of the book is $10.00, express prtpaid. S. E. Hndricks Co., 74 Lafayette Street, New York, publishrs.

NEW CEMENT PLANTS TO BE BUILT.

Within a few months the Ohio Cement Co., Majestic Bldg., Detroit, Mich., expects to let the contract for the construction of a 3,000 bbl. plant located at Hamden, Ohio, within a few months. The company has a brick plant under construction and as soon as the latter is completed the construction of the cement mill will be commenced.

* * *

The Maryland Portland Cement Company, of Baltimore, proposes to change its title to the Security Cement & Lime Company, with a capital stock of $2,000,000 and a bond issue of $1,000,000. It provides for taking over the Berkeley Limestone Company and properties at Martinsburg, W. Va., and operating a large modern plant for the production of lump lime, hydrated lime-and other lime and stone products, the daily output of lump lime being 2,000 barrels. Dr. Lazelle, of the Charles Warner Company, Wilmington, Del., will be the engineer in charge. The Security Cement & Lime Company will probably organize with the following officers: President, A. W. Page, president of the Nazareth Cement Co., Nazareth, Pa.; vice-president, Chas. Warner, of the Charles Warner Company, Wilmington, Del.; secretary-treasurer, Loring A. Cover, president of the Maryland Portland Cement Company. The latter company has determined all details for its recently announced enlargement of the plant at Security, Md. Its improvements will include the erection of a 100x200-foot concrete and steel stockhouse costing-$45,000, the installation of all two kilns 128 feet long by 8 feet in diameter, the addition of a 1,200-horsepower steam turbine to the 1,400-horsepower steam engines now used, the installation of all accompanying equipment, and the erection of a crusher to furnish stone for manufacturing cement, ballasting and othe purposes. These improvements are to be completed by next May and will increase the company's daily output from 800 to 2,400 barrels of Portland cement. The engineer in charge of these improvements is F. H. Lewis, of Leeds, Ala., who was in charge of planning and constructing the original plant. The Marvland Company increases its capital stock from $400,000 to $800,000 in connection with the improvements.

* * *

Work has been stopped at the plant of the Cayuga Lake Cement Company at Portland Point, N. Y., preparatory to enlarging the plant to twice its present size. M. E. Calkins, president, says the company has been unable to meet the demand for its product making this enlargement an absolute necessity.

* * *

Spokane, Wash.—Three million dollars is the stated capitalization of a corporation headed by J. S. Irvin of Ottawa, Ont., managing director of the International Portland Cement company, with a capital of $2,000,000, and head of the Exshaw Portland Cement company of Alberta, which purposes to erect a cement factory near the town of Orofino, Idaho, southeast of Spokane, where it has acquired 223 acres of clay and lime beds, known as the J. M. Bartlett tract.

The plant, covering 12 acres under a single roof, involves an initial expenditure of $1,500,000, and will be the largest of its kind in the United States. C. A. Reid of Spokane, will be manager, with R. B. Hassan and R. J. Klossoki as engineers. Dana Child, a millionaire of Spokane, is heavily interested in the project. Three hundred men will be employed, turning out 2,500 barrels of cement daily. Storage rooms will be built for 30,000 barrels of finished product, 20,000 barrels of clinker and 30,000 barrels of lime and clay. Work on the foundation will begin early next January.

Experts say that the Bartlett tract probably contains the richest deposit of lime in the United States, the pro-

duct being 99 per cent pure. No better location could be secured. On one side towers the mountain lime and on the opposite side of the canyon is an immense deposit of clay, containing silica and alumina for excellent cement manufacture, while between these two immense deposits will be located the factory.

Gravity will place the matter in the plant ready for grinding and treatment. Until other arrangements are made coal for the burning rooms will be shipped from Wyoming and Montana. The company now has negotiations under way for the installation of an electric plant on one of the creeks above Orofino, these plans at this time being immature.

Asked if John T. Humbird, president of the Humbird Lumber company, a Weyerhaeuser property, which has rich holdings in northern Idaho, near the proposed factory, is interested in the enterprise, Manager Reid said:

"Mr. Humbird has no connection with our corporation. He has holdings in the vicinity and may be looked upon as a possible purchaser of the cement manufactured because of it being desirable for the construction of plants proposed by the Weyerhaeuser syndicate in that district."

* * *

Boise,Idaho.—There has recently been incorporated the Bruneau Cement company, with the following, all of Boise, as officers and directors:

J. S. Jellison, president; L. E. Eck, treasurer; Frank M. Eby, secretary. These, with H. Clark, Thomas Ryan, S. E. Vance, S. E. Vance, Jr., and C. S. Polk, comprise the board of directors. Mr. Polk is also vice president. This company has been organized for the purpose of exploiting one the most valuable cement deposits discovered in recent times. In fact the opinion has just been declared by one who is familiar with such beds, both in this country and abroad, that this tract will be the largest and most valuable in the world. The property is located ab ut seventy miles from Boise, it being located in Owyhiw county, thirty miles from the Oregon Short Line. The new railroad from Buhl to Oregon is located directly through it. It is over three milaes long and comprises over a thousand acres. There is a 10 to 12 foot ledge of lime rock with absolutely no wash or waste on top of it. The cement rock lays on four hundred feet of clay which is exactly the right kind for manufacturing Portland cement. No cheaper proposition for the manufacturing of Portland cement has ever been found anywhere.

Like all deposits of such magazines it was difficult at first to get any capitalists interested enough to go and examine it. The find was located last year. The value of the deposit has been favorbly reported on by experts The following is an analysis of the average rock:

The following is an analysis of the average rock:

	No. 1.	No. 2.	No. 3.
	P.Ct.	P.Ct.	P.Ct.
Insoluble in H Cl (Silicates)...	82.20	83.75	5.1
Calcium (CaO) lime	2.10	1.96	50.87
Magnesia (MgO)	1.89	1.65	.68
Alumina ($AL_2 O_3$)	10.36	8.85	1.31
Iron ($Fe_2 O_3$)	2.34	2.85	.94
Sulphuric acid (SO_3).....	Trace.	Trace	.14
Carbondioxide (CO_2)	None	None	40.70
Alkalies and undetermined	1.11	.94	.26
	100.00	100.00	100.00

No. 1 and No. 2 are clays, and No. 3 is lime rock.

* * *

Oklahoma capitalists are financing a project to construct a cement plant near Tulsa, Okla. E. E. Gainer and C. T. Shyrock, of Tulsa, Okla., are interested in the proposition..

* * *

It is announced that operations will be started early next month at Oswego, six miles from Portland, Ore., in preparation for the erection of a 1,500 barrel Portland cement plant for the Portland Cement Co. The buildings will be of reinforced concrete.

CEMENT MILL NEWS.

W. E. St. Clair, traveling freight agent of the B. & O. R. R. has resigned, effective on August 1st, to accept the position of sales manager of the Castalia Portland Cement Company.

* * *

The total output of cement in Germany in 1908 is estimated to be 25,900,000 casks of 180 kilogs, of which 23.0000,000 casks were Portland cement, 2,250,000 casks "iron" Portland and Schlodron, and 650,000 casks Roman. The 142 factories in Germany, of which ninety-seven manufacture only Portland cement, have, according to the report of Sir W. Warr, C. V. O., Consul-General at Hamburg, an estimated capacity of nearly twice last year's output, which fell considerably below early expectations. This was due to the financial crisis, which not only checked new building enterprises, but also alterations and additions to existing premises.

* * *

W. B. North, formerly connected with the Western States Portland Cement Co., Independence, Kans., has been appointed chief chemist of the Southwestern States Portland Cement Co., Dallas, Tex. M. M. Ludlow, formerly with the Northwestern States Portland Cement Co., has been appointed assistant chemist at the Dallas plant.

* * *

J. W. Ballon has been appointed manager of sales of the "Trinity Brand" manufactured by the Southwestern States Portland Cement Co., Dallas, Tex. Mr. Ballon has been connected with sales of Portland cement for years in the Michigan district and till recent date with the Iola Portland Cement Co. Our best wishes for success accompany Mr. Ballon to the South.

* * *

According to the returns made to the Dominion government by the cement manufacturers of Canada, the average price obtained by them at their works during 1908 was $1.39 per barrel. This was the lowest price ever reported by the Canadian mills. In 1906 the average price was from $1.65 to $1.70, and in 1907 about $1.60. At the beginning of the present year it was alleged by a number of manufacturers that even without any increases in price the business would be rendered more profitable by merging the large competing companies into one gigantic concern, so as to be able to control the price and the output.

* * *

The Dixon, Ill., plant of the Sandusky Portland Cement Company made a new capacity mark for one day's output recently when they loaded and shipped 43 cars of cement. The shipments were about equally divided between the Illinois Central and Northwestern roads. All in all the day was one of the busiest since the plant was opened two years ago.

* * *

Attorney Dwight Harrison of Columbus, Ohio, purchased at receiver's sale the plant of the Union Portland Cement Company at Rushylvania. The plant was sold

at public sale and Mr. Harrison, as trustee for the bond-holders, bid the property in at $26,170, which was two-thirds of the appraisement. The factory, it is said, is to be dismantled.

* * *

The plant of the Alma Cement Company, Wellston, Ohio, resumed operations October 1.

* * *

A party of Baltimore business men and bankers yesterday inspected the plants of the Security Cement Company near Hagerstown, Md., and Berkeley, W. Va.

A special train bearing the party left Baltimore in the morning and arrived at Hagerstown about noon. Managers of the plant explained every phase of the manufacture of cement.. Continuing to Berkeley, the vast quarries of limestone used in the manufacture of steel by the open-hearth system were visited and a descent of over 125 feet made to the bottom of the excavations.

* * *

The Atlas Portland Cement Company has increased their capital stock from $10.000.000 to $10.250.000.

* * *

We do not wish to assume that a poor country editor is wiser than the average prosperous farmer of Harper county, nor that our business acumen is keener than that of many who are buying cement stock. It is not a pleasure to herald abroad that Harper county is a productive field for sharpers, yet from daily information that comes to our humble sanctum we are led to believe that there are quite a few farmers in Harper county who are pouring thousands of good dollars into rat holes by purchasing cement stock from high salaried salesmen.

We know of a well-to-do family in Southwest Missouri who recently lost $25,000 in the Guthrie Mountain Cement Company, and this same family is now spending more money in an effort to send the promoters of that company to jail. From the same source of information we also learn that this same busted corporation is now being merged with a Humboldt, Kansas, cement company.

An attorney for his family went to the Kansas State auditor's office and found that there is only one cement company in Kansas, an Iola company, that has ever paid any kind of dividends to stockholders. He also found that out of ten such projects floated in Kansas in recent years seven of them have failed or have went into the hands of a receiver which means invariably that the country stockholder is to be frozen out.

New ones are being organized. They employ high salaried salesmen from the insurance companies to sell stock. They send out a glowing prospectus, and for every share of preferred stock sold they give the purchaser one of common stock, with the statement that just as soon as the company begins to sell its product all the preferred stock will be retired and cancelled and the holders of common stock will then begin to realize dividends on something that cost them nothing.

(Anthony, Kans. Herald.)

* * *

The Alpha Cement Co., of Easton, Pa., has purchased a controlling interest in the Catskill Cement Co.'s plant at Cementon, N. Y.

* * *

The Monarch Portland Cement Co. has established a sales office at 208 Arlington building, Kansas City, Mo. W. H. Rhodes is the manager of this office.

* * *

The supreme court of Michigan Thursday handed down the decree in the case of Orlando L. Torrey against the Toledo Portland Cement Company, which organization operated in Manchester some time ago but was later on forced to the wall.

According to the decree of the court Randall T. Van Walkinburg is to pay $26,627.76; Charles Cooley, $6,-656.94, and Dr. William Watts of Toledo, $6,686.94.

The court also ordered that in event the amounts assessed are not paid by the defendants in the cause, an execution shall be issued against their properties and the amounts collected by process of law.

This decree is taken as an indication that like judgments will be entered against two of the other promoters for about the same amounts. Two other promoters are also expected to receive a like treatment at the hands of the court.

The story of the Toledo Portland cement company is still fresh in the minds of the people of Washtenaw county. It appears that some time ago the company's agents came to Manchester and succeeded in establishing the business. The venture did not prove itself a success, and due to a laxity of funds, the company is said to have been forced to close its plant.

THE USE OF "CROWN" HYDRATE IN CEMENT MIXTURES.

The advantages of Hydrated Lime in cement mixtures are far from being appreciated by Portland cement workers.

Until the discovery of the "Vacuum Process" of hydration, which were adopted and tried out first by Marblehead Lime Co. of Chicago, it was not possible to hydrate high calcium lime by machinery and the use of wet lime putty was impracticable, because of the extreme difficulty in mixing it with cement and sand.

While it is true that the advantages of lime paste or putty in Cement Mixtures have been well known by European and American Engineers for many years, as shown by highest authorities, still, the great difficulty always encountered in accomplishing anything like a thorough or even "mix" of wet lime putty with cement has heretofore prevented the general adaption of this valuable knowledge in actual practice.

But fortunately the recent developments of the Hydrated lime industry effectually overcome this difficulty, as the powdered hydrate is more easily mixed than the cement itself, and there is little doubt that Perfectly Hydrated High Calcium Lime fills a long felt, urgent need and will soon be universally used in Portland Cement mixtures.

It not only makes Cement Blocks and all concrete work more water proof but it makes the work stronger, harder and tougher. It also cakes cement mortar far more plastic, free working and easier to put in place. Fully one-fourth to one-third of all Portland Cement now used could be substituted with Calcium Hydrate with great profit and satisfaction.

The principal value of Hydrated Lime is due to the fact that it is very much finer than the finest ground Portland cement, and consequently it fills smaller voids making the concrete more dense.

It is well known that even in mixtures of one part cement to one of sand, the cement is insufficient to fill the voids between the grains of sand, and, consequently such concrete is not waterproof.

If 1 to 1 mixtures are not impermeable to water, how

much more porous must be mixtures of 1 to 3; 1 to 4; 1 to 5, etc.

Moreover, as the hydrate is cheaper than cement, its use lessens the cost of concrete. The addition of Hydrated Lime to cement concrete also adds materially to the economy of working, because it makes the mortar "fat" and free working under the trowel. If used in brick work, there is great economy in the increased brick-laying capacity per man per hour, ranging from 20 to 25 per cent.

Perhaps the most remarkable effect of lime in cement mortar is that reported by U. S. Government Engineer L. C. Sabin, who is a recognized high authority. His tests show that by replacing 50 per cent of the cement with Hydrated Lime the adhesive strength or power of binding bricks together is increased 100 per cent. This is explained by the fact that the lime retains the moisture longer than cement alone, thus retarding the set, and enabling the mortar to penetrate deeper and gain a stronger grip.

This test accentuates the great advantages of using High Calcium Hydrated Lime for laying up brick, cement blocks, tiles and all porous materials.

For the identical reason that not over 5 per cent of magnesia is permissible in the raw materials from which Portland Cement is originally compounded and, as that percentage presumably has already gone in, it is manifestly not safe to use hydrated lime containing any magnesia, in concrete mixtures.

Dolomite or magnesia limestone contains 42 to 44 per cent carbonate of magnesia, while the high carbonate stone from which "Crown" Hydrate is burned analyzes 98 per cent carbonate of lime and shows only a slight trace of magnesia.

Being in a dry, powdered form, the mixture of "Crown" Hydrate with sand and cement is always even and uniform, leaving no fat or lean streaks in the aggregate.

To substantiate our claims, says the Marblehead Lime Company of Chicago, for the manifest advantages of "Crown" Hydrate in Portland cement mixtures of all kinds, we respectfully submit for the thoughtful consideration of Architects, Contractors and Dealers the following excerpts from papers read by some of the highest engineering authorities in Europe and America.

From an interesting paper read before the Northwestern Cement Products Association at Chicago Dec. 19, 1907, by Prof. Spencer B. Newberry of the Sandusky Portland Cement Co. we copy the following, viz.:

"Dampness has been the great reproach of concrete blocks, and if it were not for this fault, they would be used to many times the extent they now are. Yet this fault can be certainly and easily avoided by the use of the best materials, gravel containing very little sand, with the addition of hydrated lime to the amount of one-third or one-fourth the weight of cement used, enough water to make a plastic and dense concrete with thorough mixing and tamping. We have always found such blocks to resist water sufficiently to answer all practical purposes."

"Commercial hydrated lime is a dry powder and is easy to mix with cement, sand and gravel. The only method we have used is to put the materials right into the mill, mix them all together and add water. Lime paste is considered by some just as good, but it does not work as well because the material is apt to work into lumps."

At the annual meeting of the American Society for Testing Materials held at Traymore Hotel, Atlantic City, N. J., June 23-27, 1908. Mr Sanford E. Thompson M. Am. Soc. C. E. Newton Highland, Mass., read a paper on "Permeability Tests of Concrete with the addition of Hydrated Lime."

He has made a number of tests to determine the effect of adding various percentages of high calcium hydrated lime to concrete of different proportions. The following conclusions were drawn as to the result of the experiment.

1. Hydrated lime increases the water tightness of concrete.

2. Effective proportions of hydrated lime for watertight concrete were found to be as follows:

One part Portland Cement; 2 parts sand; 4 parts stone; add 8 per cent hydrated lime.

One part Portland Cement; 2½ parts sand; 4½ parts stone; add 12 per cent hydrated lime.

One part Portland Cement; 3 parts sand; 5 parts stone; add 16 per cent hydrated lime.

These percentages are based on weight of dry hydrated lime to the weight of dry Portland cement.

3. The cost of large waterproof concrete structures may be frequently reduced by employing leaner proportions of concrete with hydrated lime admixtures, and small structures, such as tanks, may be made more watertight.

4. Lime paste made from a given weight of hydrated lime occupies about 2¼ times the bulk of paste made from the same weight of Portland Cement, and is therefore, very efficient and void-filling.

(From L. C. Sabin on "Cement and Concrete," published in 1905.)

"In regard to the point of advantage obtained by adding hydrated lime to cement mortars, recent tests and experiments show, with a uniformity quite satisfactory, that most American cements will sustain without any material loss of strength, a mixture of hydrated lime equal to that of the cement. Neither is the hydraulic activity of cement mortar impaired, by the addition of the hydrate, under water or in submarine masonry, while for construction not subject to immediate immersion it is to be preferred on many accounts."

"If a high adhesive strength is desired, Portland cement should not be mixed with more than two parts sand unless hydrated lime is added to the mortar, as the use of the lime materially increases the adhesive strength of lean mortars. The use of hydrated lime with Portland cement in the amounts used in these experiments more than doubled the adhesive strength of the mortar."

"Results of adhesive tests of cement mortars show that if half of the cement in the mortar is replaced by an equal amount of hydrated lime, the resulting strength is increased by nearly 100 per cent, and that if a smaller amount of hydrate is used the adhesive strength is increased by about 150 per cent over the strength given by the cement mortar without the hydrated lime."

OUR OWN EXPERIENCE.

The walls of our new three story, fire proof hydrating mill were built of concrete consisting of one part cement; one part "Crown" Hydrate, measured dry, and six parts sand and gravel. At the end of four weeks these walls were so hard that it was with the utmost difficulty that holes could be drilled through them. The contractor who did the work is enthusiastic over the advantages by hydrated lime in Portland Cement mix-

tures. He insists that the concrete is much harder and tougher (as shown by the drillings) than can be made with cement alone. We know it is much more water proof. He also says that the mortar is much more plastic and easily and efficiently placed in forms. The floor are of concrete with one-half part hydrate to one part cement and four parts sand and gravel. We are now satisfied that we could have used double the proportion of hydrate we did in both walls and floors with even better results.

We used considerable iron reinforcement, which we are now satisfied was unnecessary. There is absolutely no doubt in our minds that the addition of certain proportions of high calcium hydrate to all concrete work greatly improves its quality and strength. The exact proportions advisable for different classes of work have not been definitely established by practical tests and experience, but that is a detail that will soon be worked out.

"Crown" Hydrate certainly has a big future in Portland Cement Blocks as well as all concrete mixtures. It only makes concrete more water proof, but, up to a certain proportion stronger, tougher and more flexible. Besides it makes the cement mortar far more plastic and easier to work. Fully one-third, if not more of the Portland Cement now used, could be substituted with high calcium hydrate with the greatest profit and satisfaction to all concerned.

THE DETERMINATION OF SILICA IN PORTLAND CEMENT.

The following experiments upon the determination of silica in Portland cement may prove of interest to our readers. They do not represent any very original ideas, but merely show the errors to be met with in this determination as usually carried out.

The first point considered was the error met with in determining silica by a single evaporation and baking the residue at 100°-110° C. for one hour. It was found that if the sample was treated in substantially the same manner each time—viz., dissolved in 20 c.c of dilute hydrochloric acid (1:4), evaporated to dryness in the water bath and the residue baker for one hour at 100°-110° C. in an airbath—the error would be practically constant for all samples of Portland cement. The following determinations illustrate this point:

No.	% SiO_2 One Evaporation	SiO_2 Two Evaporations.	Error % SiO_2
931	20.28	20.60	0.32
932	20.10	20.40	0.30
934	20.62	20.92	0.30
938	20.82	21.12	0.30
939	20.66	21.00	0.34
	Average error		0.31

A number of determinations were also made to ascertain the amount of silica left in soluble form by one evaporation and baking at 100° to 110° C. with shales and limestones. In the former case the sample (0.5 gram) was fused with sodium carbonate (5 grams) and the fusion dissolved in dilute hydrochloric acid (1:4); the solution evaporated to dryness and the residue baked for one hour at 100°-110° C. in an air-bath. With cement-rock (argillaceous lime-stone) the sample was heated for ten minutes with an equal weight of sodium carbonate, first over a burner and then over a blast lamp, the sintered mass dissolved in acid, evaporated and baked as above. A few of the results follow:

Sample of—	% SiO_2 One Evap'n.	% SiO_2 Two Evap'ns.	Error % SiO_2
Shale	68.36	68.90	0.54
Shale	61.32	61.84	0.52
Cement-rock ...	12.88	13.12	0.24
Cement-rock ...	13.66	13.90	0.24
Cement-rock ...	12.76	13.04	0.28
Cement-rock ...	12.84	13.12	0.28

Average error for shale 0.56
Average error for cement-rock 0.26

It will be seen that the error where the silica is dehydrated by baking in an air-bath at 100°-110° C. for one hour is, in the case of Portland cement, approximately 1.5% of the total silica present, in the case of cement-rock 2%, and in the case of the shale 1.2%. Where one evaporation is used, therefore, and the sample is baked at 100° C. for one hour, the silica may be corrected by the use of the formula—

True % SiO_2 = % SiO_2 found by one evaporation × 1.015.

In the case of the cement No. 939 this would give 20.66×1.015=20.97% instead of the 21.00% actually found by two evaporations.

With respect to the impurities in the silica, a large number of determinations made by the writer show that where Portland cement is attacked by dilute hydrochloric acid (1:4) and is almost completely soluble in this, leaving only a slight flotant residue, the impurities amount to almost exactly 1.5 per cent of the weight of silica found. In other words, the impurities in a silica from cement weighing 0.1012 will be 0.0015 and in one from cement-rock weighing 0.0675 will be 0.0010. Expressed as a formula the correction due to impurities will be:

True % SiO_2 = % EiO_2 found by two evaporations — % SiO_2 × 1.015.

With respect to the iron and alumina determination, where one and two evaporations are made, the following results do not seem to indicate that the silica which remains in the filtrate is all precipitated here or indeed that any considerable portion of it is thrown down with the iron and alumina:

	% Fe_2O_3 + Al_2O_3 One Evap'n for SiO_2.	% Fe_2O_3 + Al_2O_3 Two Evap'ns for SiO_2	Error % Fe_2O_3 + Al_2O_3
Cement	10.02	10.00	0.02
Cement	10.38	10.36	0.02
Cement	9.90	9.84	0.06
Cement	10.14	10.12	0.02
Cement-rock ...	7.00	6.98	0.02
Cement-rock ...	6.40	6.32	0.08
Cement-rock ...	6.22	6.12	0.10

The impurities (SiO_2) found in the iron and alumina precipitate in these determinations amounted to 0.0006 to 0.0008 grams or a correction of approximately 1% of the total iron and alumina present. In making these iron determinations, ammonia free from SiO_2, kept in wax bottles, was used. In the case of the iron and alumina, therefore the correction to be applied when only one evaporation and no purification of precipitates are made may be expressed as follows:

True % Fe_2O_3+Al_2% O_3=(% Fe_2O_3+Al_2O_3 found) − (% SiO_2 found × 0.015) — (% Fe_2O_3 + Al_2O_3) × 0.01.

The true silica may be found by use of the formula. True % SiO_2 = % SiO_2 found + (% Fe_2O_3 + Al_2O_3 × 0.01.

These formulæ, of course, only apply to cases where the silica and the iron and alumina are determined by the methods outlined above. Applying them to a cement which gave on analysis: Silica, 22.10%; iron oxide and alumina, 8.74%, we have, Silica = 22.10+8.74×o.01= 22.19 and iron oxide and alumina =8.74+22.10×0.015 —8.74×0.01=8.98. On analysis using two evaporations and purifying both the silica and the iron and alumina precipitates, the silica was found to be 22.22 and the iron oxide and alumina 10.00. It will be seen that the error in the case of the silica is much less than is that in the case of the iron and alumina. Neither, however, are considerable enough to make a technical analysis untrustworthy.

The subject of the use of porcelain and glass vessels for the determination of silica was also investigated Kortwright in (CHEMICAL ENGINEER, Vol. V. p. 19) showed the error in silica due to the use of porcelain dishes, and the writer's conclusions bear out his contentions. The following determinations made in glass dishes, porcelain dishes and platinum dishes show the errors to be met with from the use of the two former in cement analysis:

	Per Cent of Silica		
	Class Dish.	Porc. Dish.	Flat Dish.
Cement	20.48	20.34	20.56
Cement	21.12	21.00	21.22
Cement.....	20.82	20.68	20.96
Cement-rock ...	12.84	12.72	13.12
Cement-rock ...	12.18	12.00	12.28

It will be seen from the above that loss of silica occasioned by the use of porcelain dishes is much greater than that caused by making only one evaporation to dehydrate silica and also that glass dishes are better for this purpose than are porcelain. In these determinations, old porcelain and glass dishes were used, as it was suggested that the amount of silica deposited by one analysis might be rubbed off or dissolved in the next. The error seemed to be the same, however, whether neew or old dishes were used.

In the standard scheme of analysis recommended by the New York Section of the Society of Chemical Industry, occurs the following: "One half gram of finely powdered substance is to be weighed out. . . . It is then transferred to an evaporating dish, preferably of platinum, for the sake of celerity in evaporation," etc. As a matter of fact, celerity of evaporation has very little to recommend platinum in comparison with the need of its use where accuracy is desired. Experiments showed platinum to evaporate the samples two minutes quicker than porcelain and six minutes quicker than glass, while the amount of silica which would remain on the sides of a glass dish would amount to as much as that recovered by the second evaporation. So that the real need of the platinum dish is for accuracy and not celerity.

(Wm. P. Gano, chief chemist Pennsylvania Cement Company, Bath, Pa.)

NEW CEMENT PLANTS TO BE BUILT.

Contracts were recorded in San Bernardino, California, in September 22, by the Arrowhead Portland Cement Co., for the erection of a one-thousand barrel per day mill, to be located at Etiwanda, San Bernardino County. Smith, Emery & Co., Chemical Engineers, of San Francisco, will have entire charge of the work, and it is proposed to have the plant finished and in operation inside of twelve months. The cost of the mill and equipment will be about $700,000 the greater portion of the capital being furnished in Los Angeles. Two surveying parties are in the field, one locating the five miles of railroad connecting the mill with the Santa Fe road at Etiwanda; the various buildings, quarry faces, etc. The preliminary plans have been completed, and the grading and construction work were to begin on September 27. This makes the third cement mill for San Bernardino County.

* * *

Oscar O. Ayers and others interested are arranging for a site for a Portland cement plant, at Ardmore, Okla. The contemplated daily capacity is 5.000 barrels, reported cost $1.000.000. Work is to commence in the spring of 1910.

* * *

Kendall, Wash.—The International Lime Co. has commenced the construction of a plant, with a daily capacity of 500 barrels.

TRADE NOTES.

The Building Mechanics' Ready Reference. Cement Wrkers' and Plasterers' Edition. By H. G. Richey, Superintendent of U. S. Public Buildings. Page, 458. Size 16mo. Morocco, $1.50 net. John Wiley & Sons, New York and London, 1908.

Mr. Richey is well known as a practical and helpful author of handbooks for the artisan. His book for superintendents of construction, arcihtects, builders and buidding inspectors, published in 1905, has had a large sale, and his "Guide" to carpenters and mechanics is a standard. The present book is addressed more particularly to workers in concrete and plaster, and it is full of handy information. There is comparatively little literature on thè subject of these two trades that is of a practical naturefi and Mr. Michey certanly knows what he is takling about.

Much of the information has been put in tabular form, where it is availablt at a glance, and the text is written in simple and easly understood language. The seven parts into which the work is divided cover the fitld very thoroughly and will be of interest to everyone on the job, frm the man with the wheelbarrow to the superintendent of th gang. A chapter on laying out work will be of particular value to the ambitious owrker who wants to rise. The book is substantially bound and is of such a size that it may well form a part of the hip-pocket library.

* * *

Users of Hercules concrete block machines should not forget the prize contest now being carried on by the Century Machine Co., of Rochester, N. Y. Five cash prizes will be awarded for the five best examples of concrete block construction. Those who have erected any buildings with Hercules blocks, or whose blocks have been used in any buildings that would appeal to builders generally, should write the Century Cement Machine Co., Rochester, N. Y., for information relative to their prize contest. Every maker of Hercules stone should avail himself of this opportunity to not only secure a prize, but to bring before the building public generally the finer examples of their work and, in this way, assist in upbuilding the block industry. Prizes will be awarded at the next meeting of the National Association of Cement Users to be held in Chicago, February 18 to 26, 1910, so it will be well to act promptly.

State Manufacturing Co., Norfolk, Va., recently reported incorporated with $20,000 capital stock, will erect plant for manufacturing concrete floor beams and building materials; cost of buildings, $4000; J. F. W. Fawcett, president.

* * *

The Rockford Engine Works, Rockford, Ill., is now manufacturing a line of engines suitable for concrete mixers, block plants, etc. This company makes a complete line of machinery, including stationary and portable engines, sawing rigs, plain and friction clutch pulleys, pumping jacks, magnetos, supplies, etc. The company will be glad to send its literature to any address.

A JOINTLESS CONCRETE SEWER PIPE.

Various forms and systems of concrete sewer construction have been mentioned in previous issues of our paper. These have developed until this is one of the most universal types of sewer construction in use. Joseph Hickson, of Mt. Gilead, Ohio, is the inventor of a form for a monolithic sewer pipe which has met with no little success.

The forms are of steel and so jointed as to form a continuous jointless pipe. The shell is of steel and the centers or cores are first placed in the bottom of the trench. The whole circle of the shell is laid at one time. The shell is supported with turn buckles inside and allowed to remain until the concrete has set. Then the shell is taken out, as it is collapsible.

The forms into which the concrete is poured may be removed after the set has been obtained. These are easily taken out by hooks, drawing each section out of the trench.

ITEMS CONCERNING CONCRETE CONSTRUCTION.

Detroit, Mich.—Fifty-five acres opposite Palmer park on Woodward avenue, have been purchased by Lawrence W. Snell, U. G. Race, Ald. Burton, Chas. Clippert, and Dr. Tapert, and will be plotted at once and converted into the most up-to-date residence section in the city.

Concrete houses of the newest and most approved design will be erected for sale on the contract plan at from $2,500 to $3,000.

* * *

The Eaton Cement Tile company of Eaton, Ohio, was recently incorporated by F. B. Husted and others; $20,000.

* * *

Bloomington, Ill.—The foundation has been laid for one of the three concrete houses which are to be erected by Harvey Johns at the northeast corner of Market and Madison streets. These houses are to be modern, and up-to-date in every particular.

* * *

In the orange garden of the old Capucian monastery, on the hillside about three hundred feet above the Gulf of Amalfi, Italy, there are a number of queer mushroom-shaped tables. These tables, apparently used by the monks for reading purposes, are about two and a half feet high and three feet in diameter at the top and two feet at the base. They are of concrete, and though, according to local authorities, of an age varying from four hundred to eight hundred years, are in an excellent state of preservation. The excellent condition of these old tables furnishes additional proof of the durability of concrete as applied to lawn and garden ornaments.

EUREKA WATER SOFTENER.

The Dodge Manufacturing Co., Mishawaka, Ind., has just closed a contract with the Acme Cement Plaster Co. by which a Eureka water softener and purifier will be installed at the Acme, Tex., plant of the company.

For a long time the Acme people have used water from Groesbeck creek which flows through a gypsum district, and is highly charged with scale forming ingredients. Many boiler troubles have been the result.

The Groesbeck water was given a thorough analysis at the laboratories of the Dodge Manufacturing Co., and

it was developed that of 143 grains of incrusting solids contained in each gallon, 121 are gypsum in solution.

The Eureka apparatus for the Acme people will have a capacity of 4500 gallons per hour, thus making a supply for all needs of pure, soft water. The machine will be built especially to suit the conditions at Acme, according to the water tests..

The Acme Plaster Cement Co. is one of the best known concern of its kind in the country and operate a number of other plaster cement plants besides the one at Acme. The general offices are at St. Louis.

ANNOUNCEMENT.

After November 10th our General Sales Office will be removed to our works at La Salle, Illinois, where all future correspondence pertaining to sales or shipments should be directed. This change has become necessary because of our largely increased business and will enable us to give our patrons even more careful attention and better service than heretofore. The Sales Office will be in closer touch with every detail of the manufacturing department and in a better position to look after the interests and to meet the varied demands of our trade.

We will retain our present Chicago Offices in the Marquette Building. Mr. Gold Williams will be our Chicago representative in charge of the Local Sales, Advertising and Traffic Departments.

Marquette Cement Manufacturing Company,
Wm. Dickinson, Sales Manager.

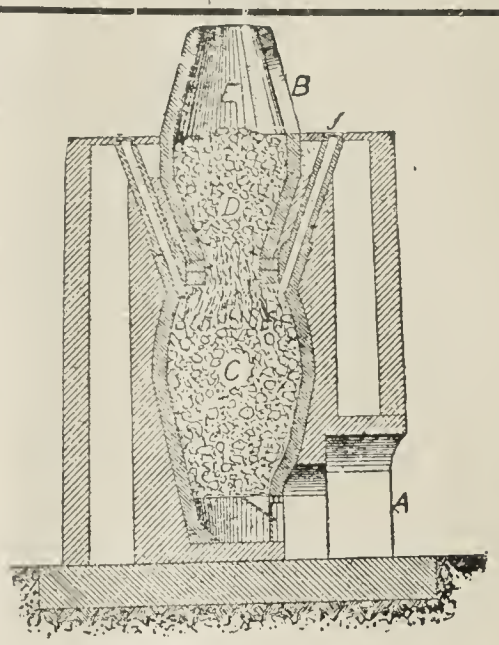
NEW PLANT NEARLY COMPLETE.

The Allentown Portland Cement Company is making rapid progress in the construction of its new plant at Evansville. General manager Charles A. Matcham, of Allentown, expects to have the plant in operation by New Year. This company has also leased the Vindex cement plant at Molltown and is repairing it. Mr. Matcham says he hopes to start the Vindex mill about the same time as the Allentown Portland plant, the two together producing about 3,000 barrels a day.

Congressman John H. Rothermel has been active as an attorney in securing this industry for Berks county and Louis F. Kraemer, of Reading, is one of the directors. The enterprise is capitalized at $2,000,000.

The plant was designed and is being built by the Fuller Engineering Company, of Allentown, of which Mr. Matcham is president. He is being assisted by J. W. Fuller, general manager; R. S. Weaver, secretary-treasurer, Richard K. Meade, chemist, and H. S. Barnhurst, mechanical engineer.

The Georgetown Vault and Concrete Co., Georgetown, Ill., is now the manufacturer and selling agent for the Bratton burial vault. This consists of two separate vaults, one being an inner vault which is made entirely of steel and makes the receptacle for casket, while the outer vault is made of reinforced concrete. Both vaults are then entirely sealed by means of a groove left on the bottom piece, into which concrete is poured, the heavy concrete cap settling into this soft concrete, making a perfect seal for both steel and concrete vaults. The company claims that this seal at the bottom makes a stronger vault than the ordinary method of sealing at the top. Further particulars can be obtained by addressing the company.



The Kiln & Chimney Construction Co.
197 HAVEMEYER STREET
BROOKLYN, N. Y.

We build Kilns for burning Lime and Cement, also

CHIMNEYS

REPAIRING and REMODELING our SPECIALTY

2c Will Mail This Ready-Made Letter

Sign your name, check off what you are interested in, and mail to-day:

Miracle Pressed Stone Co.,
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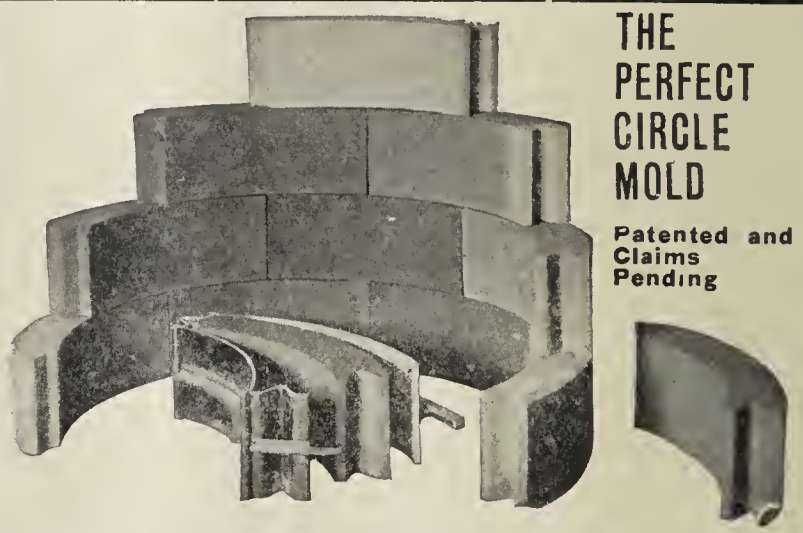
GENTLEMEN:

Please send me FREE your new **1910 CATALOGUE** showing new features; Collapsible Steel Forms for Culvert, Conduit and Sewer Work; New Magic Tamper; New Revolving Sand Screen; Miracle Positive Feed Continuous Mixer; New Ornamental Molds and other new developments. Also include your Latest Discount Sheet.

I am especially interested in (check off below.)

Double Air Space Block Machines	
Side Face Single Space Block Machines	
Face Down Single Space Block Machines	
Special Plates for Ornamental Work	
Brick Machines (3 styles)	
Cement Pipe Molds	
Bell Attachments for Above	
Bevel and Tongue for Above	
Batch Mixers	
Continuous Mixer (Special Booklet)	
Collapsible Steel Forms	



THE PERFECT CIRCLE MOLD

Patented and Claims Pending

The Perfect Mold was invented by C. S. Wert, of Kendallville, Ind. Manufactured in any sizes. In ordering give the Inside Diameter. The three most in use are No. 1, with diameter of its circumference 3 ft; No. 2, diameter of its circumference, 5 ft. No. 3, diameter of its circumference, 7 ft. Also 10, 12 and 14 ft. Diameters used for silos.

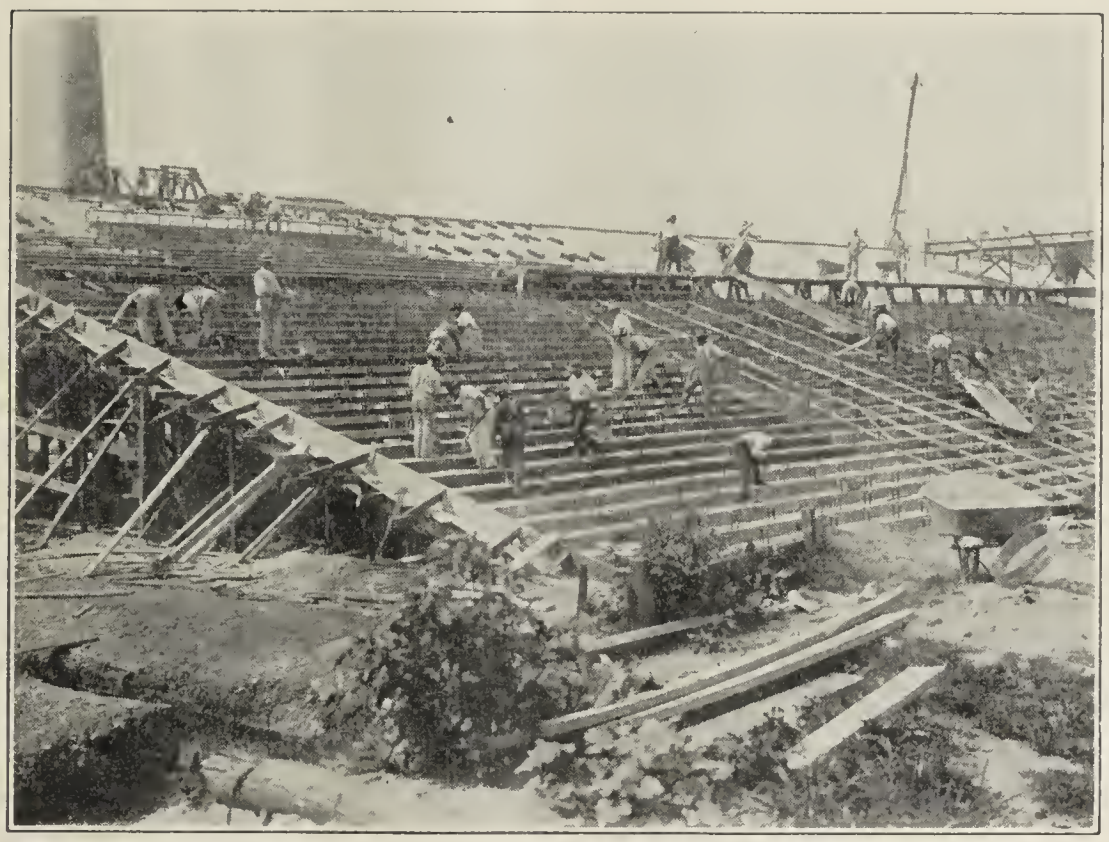
CONSTRUCTION.

The circle mold is built of No. 10 gauge sheet steel, reinforced with T-Iron. The molds are 8-in. high, 4-in, thick, making them strong and durable. These curbing blocks can be made on the ground or floor, or can be made on wooden pallets. Those in the concrete manufacturing business cannot afford to do without one of these molds, as all up-to-date concrete plants are equipping themselves with one or more of my curbing molds, for they all see at a glance their importance and utility, simplicity in operation, durable construction, and lasting qualities in products, as well as completion of a well equipped plant, showing the ability of a man's occupation or business. These molds are no experiment but an up-to-date invention, practicable, durable, simple and useful, and are only appreciated by those who have them in store. Selling at a price within reach of all. The output of these molds is grater than can be produced on any other mold, thus reducing the labor and cost of making the products, and also increasing the **Profits.**

These molds will enable you to make better products than can be produced on any other machine or model and sell for more money. Just what an up-to-date concrete constructor needs is an up-to-date plant. In a class by themselves, possessing many advantages over all others. Absolutely the best and cheapest molds ever offered to the public.

Do you know that 99 concrete cement men out of every 100, who are successful in their business, purchase the best molds in the land, and they are found and manufactured by C. S. Wert, who is the inventor, manufacturer and sole owner. Write for prices. Address, **C. S. WERT, 602 N. Main Street, Kendallville, Indiana.**

CEMENT
.....AND.....
ENGINEERING NEWS



Concrete Bleachers at Philadelphia Base Ball Park.

See Page 414.

CEMENT AND ENGINEERING NEWS

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JOHN F. WALDRON - - - - Advertising Manager

CHICAGO, DECEMBER, 1909.

DEVELOPMENT OF AMERICAN CEMENT INDUSTRY.

In reviewing the development of the American cement industry, we must admit that, during the last decade, the Portland cement manufacturer has fully done his duty in bringing his product up to the highest standard. This statement is true to such an extent that no higher grade of Portland cement can be found in any part of the globe. Cement manufactured in this country is expected to conform with the specifications of the American Society of Civil Engineers, which are equal to the most rigorous rules of other countries, and practically the products of all mills come up to this standard. In fact, no company can afford to allow its cement to leave the factory without having ascertained by careful tests that every car load complies with the required specifications.

In the same way as in European countries, the American Association of Portland Cement Manufacturers has succeeded in bringing about this change from more or less arbitrary conditions to the production of a standard article throughout the country. The question, therefore, whether or not a still further improvement can be looked for in the development of Portland cement manufacture, must be denied. It would be useless, because not economic, to grind Portland cement more finely with the expectation to increase its sand carrying capacity; nor can the market price be decreased, as it is nowadays as low as can be expected. The selling price has practically settled down to a figure which leaves only a small margin of profit compared with former earnings, but which nevertheless permits of fair dividends to the stockholders in the case of well-managed plants.

However, a branch open to improvement in the cement trade, and one in which extension of knowledge and standardization of methods are most ardently desired, is the application of cement. Upon this we should concentrate all our efforts in the future. It was comparatively easy to summon all cement manufacturers to special meetings arranged for the discussion of standard rules of manufacture; but a vastly more difficult problem confronts a body of engineers aiming to compel every consumer of cement to assume standard methods. Much excellent work has been done in this direction, but by far the greater part of the work remains to be done. The building departments of our largest cities are gradually adopting a code that promises to safeguard concrete construction, but this alone does not suffice. Every contractor must seriously aim to do his share in establishing a reputation for American concrete construction in the same manner as the cement manufacturer has done in producing the article. Putting the blame for poor work upon the cement is a bad excuse nowadays and can be disproven in almost every instance. Faulty handling of the material, ignorance in making proper use of it and lack of knowledge of the intrinsic properties of cement are generally at the bottom of all failures. In spite of a comprehensive literature, embracing every branch of the cement industry and of concrete construction, the call for "light, more light," can still be heard as loud as ever.

ANNOUNCEMENT.

With the January issue of 1910 we are going to begin a series of papers comprising the classic cement literature of Europe, that is to say, the most important contributions made by German, French and Russian authors during the last years.

These publications will be translated by Dr. W. Michaelis, Jr., who, through his excellent work, has made accessible to our readers a number of valuable papers heretofore.

As the papers we refer to, for instance, those of Unger, Schott, Feret, Candlot, Glasenapp, are quoted almost daily in the cement literature, and as they contain much valuable information derived from researches made partly at the laboratory and partly during actual construction, we feel confident those of our subscribers, who are unable to read foreign languages, will welcome the opportunity of becoming acquainted with these publications.

The first paper to be presented to our readers will be an essay by Professor M. Glasenapp, a Russian scientist, on "Plaster, Overburnt Gypsum and Hydraulic Gypsum," a subject about which much confusion existed so far. This publication means a complete revolution in the classification of gypsum products inasmuch as it demonstrates that, up to this time, almost exclusively the lower grades of plaster have been manufactured and used, while the superior kinds of gypsum products, especially hydraulic gypsum, have hardly found any market. This the author attributes to the lack of knowledge on the part of the consumer who bought under the name of hydraulic gypsum the real product as well as the lower grades of slow-setting plaster.

Hydraulic gypsum (floor-gypsum or "Estrichgips" of the German literature) is, in the opinion of Professor Glasenapp, a product fully equal to the best grades of Portland cement and can be obtained only by calcining of raw gypsum at red heat (about 1,000 centigrade), while most of the "hydraulic gypsum" sold so far has been burnt at temperatures below 400 centigrade and consequently served to discredit the excellent reputation which this cement enjoyed in the opinion of the consumers who ever happened to receive the genuine product from the manufacturer.

Okeene, Okla.—J. C. Fisher, president of the Southwestern Cement Plaster Company, reports that the company will rebuild its plant recently burned. It will be a 60 x 250-foot frame building of ordinary construction, and cost $25,000. After the old machinery is assembled and the damage ascertained, plans and specifications will be furnished for new equipment. The capacity of plant is 200 tons daily.

A SUGGESTION AS TO A COMMERCIAL USE TO BE MADE OF CEMENT TESTING.

By Richard K. Meade.

The tests at the present time applied to Portland cement are designed to serve two purposes; first, to insure the permanency of the construction in which the material is used, and second, to give it the proper strength. So far, these tests have been applied largely with one object in view; namely, that of securing a cement which could be relied upon to import a fair degree of strength to concrete in which it might be used and to give a mortar constant in volume. It seems that at the present time we have reached a point when we can go farther than this, and it is the intention of the present paper to suggest that the fineness of Portland cement or its tensile strength when tested with sand either or both be used as an actual indication of its commercial value.

Specifications are more and more beginning to recognize the fact that it is not only a case of securing a material which is free from defects, but also of securing a material which will be the best possible for use in the construction, or certainly the best possible which may be obtained within the limits of the figure which it is designed that the completed work shall cost. The specifications now drawn up by the United States government experts for the purchase of coal do not merely define a certain maximum limit for sulphur and ash and a certain minimum number of British thermal units which the coal shall possess, but go further and purchase the coal upon a sliding scale by means of which the dealer gets some of the advantage of extra quality. Why cannot a similar sliding scale be applied to cement based on the cementing value?

Of two cements, both of which pass satisfactorily the tests for soundness, setting time, fineness, etc., the one which has a tensile strength 50 per cent. greater than the other, when tested with sand, is certainly very much the more valuable of the two for constructive purposes, and the fact that the second passes the standard requirements and can be bought slightly cheaper is no reason why it should be employed in preference to the other. Manufacturers should be encouraged in every way to make the best possible product which their works can turn out economically. Nothing has served to stimulate this better than wisely drawn specifications. Contractors should also be required to use, not the cheapest material which passes specifications laid down for them by the engineer, but the best material which they can put in, at a fair profit on the job. It seems, therefore, that there should be some bonus which would encourage the contractor to use the best material which he can obtain rather than the poorest which he could possibly use and still fill the legal requirements of his contract.

A cement, A, which when tested with sand in the proportion of 1 to 3 is found to have 50 per cent. greater strength than another cement, B, tested under similar conditions and with an equal amount of sand, will be found to have fully as great strength tested 1 to 4 as the second cement, B, tested 1 to 3.

This applies not only to small tensile test pieces but also to cubes made of concrete. It is therefore perfectly safe to use less of the strong cement than of the weak one and still have as good concrete as can be made by the weak cement. In the middle West engineers are beginning to write specifications which do more than merely insure against defects in the cement and which place a premium upon the best which can be used. As an example of such a set of specifications, the following paragraph taken from the specifications for a concrete viaduct to be built on Lydia avenue, Kansas City, Missouri, for the Chicago, Missouri & Pacific Railway Co., and the Metropolitan Street Railway Co. by Mr. Kenneth Hartley, C. E., may be cited.

"In case the cement used in this work should be ground to a fineness exceeding the standard specifications by more than 2 per cent. through the 200 mesh screen, the contractor may reduce the amount of cement per cubic yard of the concrete by 3 per cent. of the above quantities for each decrease of 2 per cent. in the residue retained on the 200 mesh sieve."

In other words, if the cement is ground so fine that 85 per cent. of it shall pass the 200 mesh sieve, the contractor need only use 85 per cent. of the quantity of cement in his concrete which he would otherwise have to employ. It is estimated that provided he could secure a finely ground cement for the same figure as the other, there would be a saving of 15 per cent. of the cement in the use of the former, or in the specific case of this viaduct a saving of $500. Nor is the saving entirely on the side of the contractor Since concrete made with 75 per cent. as much cement 85 per cent. of which passes the No. 200 test sieve is as strong as concrete made with the full amount of cement only 75 per cent. of which passes this sieve. As the contractor is to use 85 per cent. as much of this cement, the engineer really gains. Furthermore when a cement has low strength its composition is faulty, it is underburned, adulterated or ground coarsely. Any one of which is certainly not to be recommended in cement. Often large government and municipal works, where only the best cement should be used, employ a very poor product comparatively speaking, simply because the contractor uses the cheapest cement he can procure which will pass the specifications of the engineer.

The Kansas City specifications are along the line of all recent investigations made upon the value of finely ground cement, and indeed the quantity of cement might be reduced very much farther than these specifications allow. Our own experiments have demonstrated that this reduction may amount to 2 per cent. of the cement for each decrease of 1 per cent. in the residue retained on the 200 mesh sieve.

A handsome new booklet has just been issued by the Glidden Varnish Co., Cleveland, O., under the title of "Advanced Finishes For Modern Building Construction." These products, the company states, class among the important materials brought out by the Glidden Varnish Co. during the past thirty-five years, and have Glidden quality and reputation as their foundation. They include the following: Alkali Proof Wall Size, Concrete Floor Dressing, Waterproof Concrete Finishes, Waterproof White Finish, Waterproof Flat Finishes, French Caen Stone Finish, French Caen Stone Tints, Transparent Waterproofing, Acid and Graphite Acid Proof Coating, Liquid Concrete and Liquid Rubber. The Glidden Varnish Co. will be glad to forward free samples with specifications for use to any address on request.

THE ENGINEERING FEATURES OF THE ATHLETICS' BASEBALL PARK.

(By Michael Monaghan, C. E.)

The new home of the Athletics' Baseball Club, which occupies the north side of Lehigh avenue from Twentieth to Twenty-first street, Philadelphia, marks a new era for professional sport. The grounds, which extend 481 feet 3 inches on Lehigh avenue and 520 feet on Twentieth street and Twenty-first street, represent an investment, by Mr. Benjamin F. Shibe, of about $500,000 for real estate and improvements. The stands seat 23,000, with standing-room, exclusive of aisles and field, for half as many more.

The main grand stand, which contains 10,000 reserved seats, forms an "L" on Lehigh avenue and Twenty-first street. The building is in the French Rennaisance style, and is of red brick with terra-cotta columns, arches, cornice, etc., the color of Indiana limestone.

The entrances for grand stand and bleachers are all located in and about the tower of the grand stand at Twenty-first street and Lehigh avenue. A mezzanine passage, connecting these entrances with the executive offices, makes possible a direct, unobserved supervision of the sale of all tickets by the manager. A passage beneath the grand stand connects this entrance with the bleachers. A stairway, 23 feet in width, leads directly to the main floor of the grand stand. There are ten large exits from the stands and field.

The grand stand contains two sets of locker-rooms, shower-baths, and lounging-rooms for the players, stores, a restaurant, and the executive offices.

The bleachers, one containing a garage and the other a storage wareroom, complete the two sides of the square. The rest of the inclosure is formed by a reinforced concrete fence, 11 feet high.

A concrete rail, 2 feet 9 inches high, extends in front of all stands, and serves as a boundary for the spectators; but is not high enough to prevent the easy exit of the crowds. Gates are provided at the aisles for occasional women visitors.

Fig. 1 shows the exterior of the stands and bleachers. The bleachers, main floor, and stairs of the grand stand are of reinforced concrete. The upper floor and roof of the grand stand are steel, cantilevered trusses. Wood is used as little as possible.

Fig. 2 shows a section through the grand stand. The roof is slag on plank, the slope being about 1 to 3¾, which is about as steep as was thought well to use with slag, on account of the running of the tar in hot weather. The slope of the main truss and of the first floor are such that a point on the ground 25 feet back of home plate, as well as an average high ball, can be seen from the back seats.

The location of the main column was determined by assuming an approximate dead load over the whole truss and a live load of 120 pounds per square foot on the cantilever arm only. The column was then shifted to give zero reaction at the anchor column. This gave an anchor arm of about 46 feet and a cantilever arm of 30 feet. Later, a more accurate dead load, the application of a vertical wind load of 20 pounds on the cantilever of the main truss, and of 30 pounds on the cantilever of the roof truss, gave an uplift on the anchor column of 31,000 pounds for the worst case. As the dead load carried by this column is 93,000 pounds, the location was maintained. This gives a factor of safety of three.

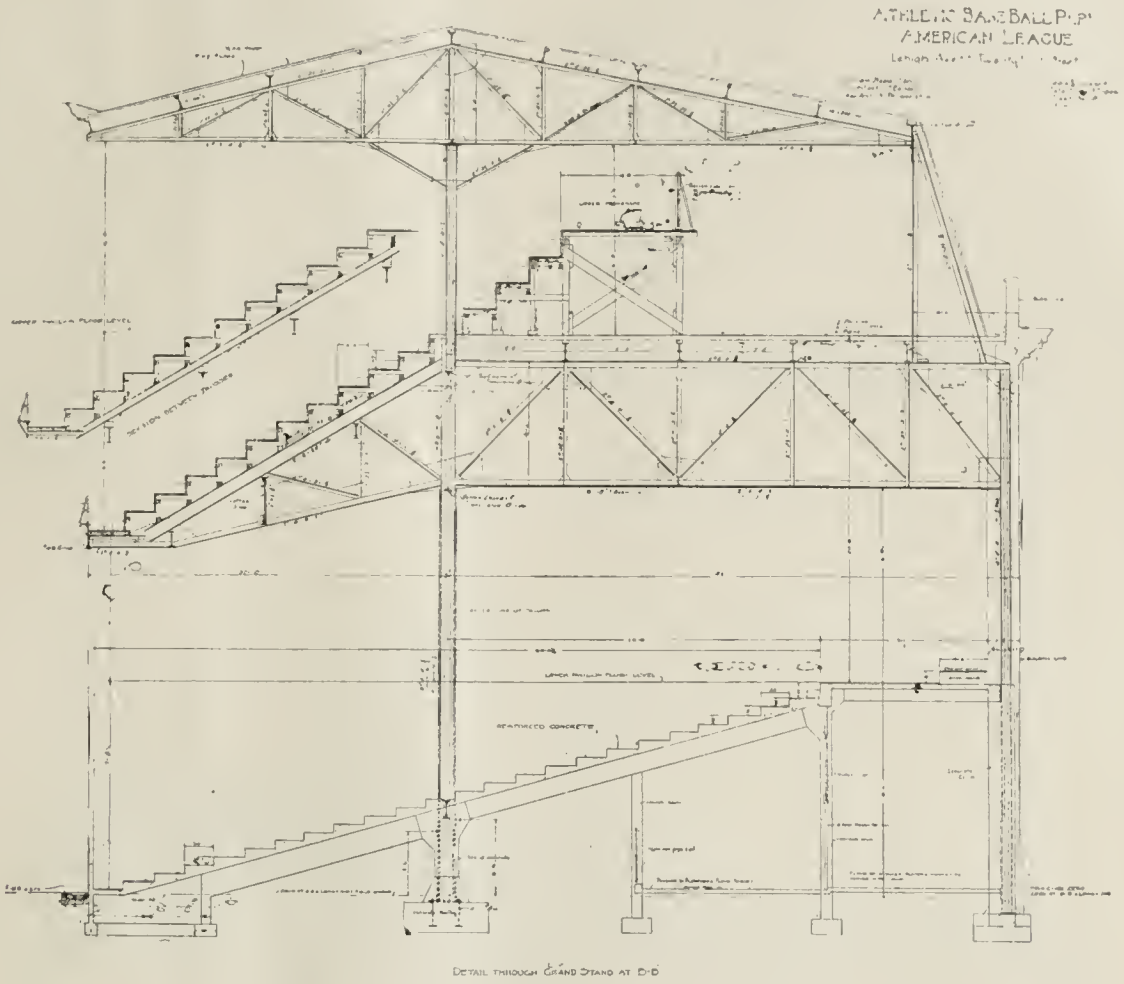
The trusses and columns are spaced 25 feet center to center transversely. This is an arbitrary assumption, the object being to make the spacing as great as possible without causing the use of extravagant secondary members. As the distance center to center of the trusses increases, the difficulty of bracing the lower chord, which is in compression for live load and wind load on cantilever, becomes much greater.

The depth of the main truss, 10 feet 6 inches, without projecting plates, was determined by the maximum shipping height allowed by the tunnels and bridges necessary to be passed in order to permit free competition among the bidders. Our first preliminary design was based on a truss with a straight lower chord. The truss was about 15 feet 6 inches deep. This gave less compression in the lower chord and simpler connections at both ends of the cantilever. The diagonals in compression were too long for economy, and the reduction in weight did not balance the added cost of erection for the deeper truss, which would have to be shipped loose. In the design adopted the anchor arm of the main truss, the cantilever of the main truss, and the whole of the roof truss were each shipped in one piece.

As the building is exposed to the wind to an unusual degree, the whole structure was thoroughly braced to form one solid unit. To prevent swaying in the direction of the trusses, the roof truss is stiffened at the forward column by two deep knee braces, and at the rear by a large gusset plate and two members which form a triangle and connect with the lower column and intermediate panel point of the main truss. The rear column, carrying the main truss, is embedded in the brick wall, which is here two feet thick, for architectural effect. The connection of the main truss with the main forward column, which consists of a web plate, four angles, and four cover plates, is made very rigid by letting the angles of the column continue through to the top chord and form an integral part of the truss. The large gusset plates of both chords are shop-riveted to the column. No knee brace was used at this point, on account of the depth of the truss, the stiffness of the connections,

and the ambiguity of stresses, which would result from deflection of the cantilever. This column is anchored to a heavy footing and incased for a length of 8 feet in the reinforced concrete work.

In investigating the main column for bending, a horizontal wind load of 20 pounds per square foot was assumed on the vertical projection of the roof truss and the steps of the main truss. Two-thirds of the moment was assumed to be carried by this column. The resultant stresses due to bending proved

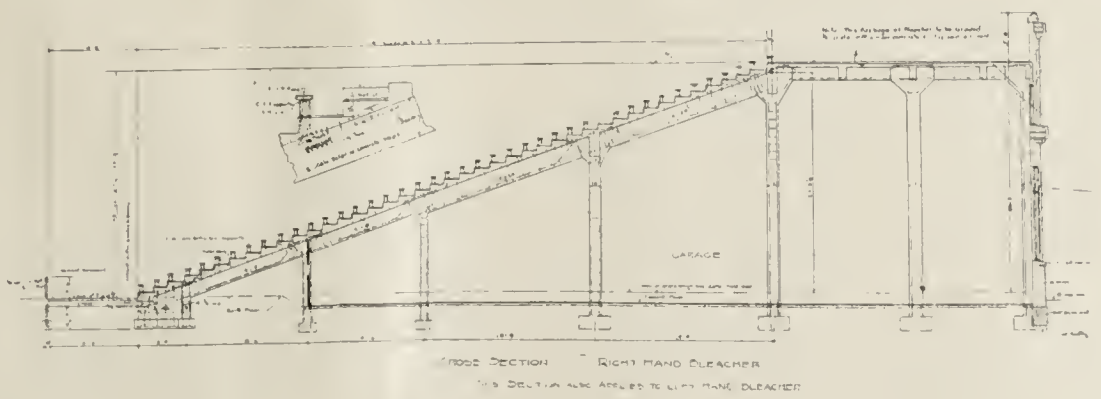


to be somewhat greater than for direct loading. For combined, direct load, and bending, therefore, the direct load would be more than doubled; but as one flange of the column would be in tension, a somewhat higher unit stress in compression was allowed. To prevent swaying in a vertical plane, transverse to the trusses, deep lattice girders were used. The roof truss has a girder 9 feet deep at the column, two 6 feet deep at intermediate panel points, and one 2 feet deep at the rear. This last is stiffened laterally by a channel to carry the thrust of the wind on the mansard roof. They all serve as purlins and brace the lower chord, which is in compression. The main truss is braced by a girder 10 feet deep at the column, the wall at the rear, and a girder 4 feet deep at a panel point of the cantilever. This last stiffens the lower chord, which is in compression. The lower chord of the anchor arm is stiffened by means of a continuous 8-inch I beam.

The design of the secondary members, where the span is so great and the load so heavy, is a very important question. For the roof purlins, 12-inch channels sufficed. The horizontal portion of the main floor consists of 18-inch I beams, 9 feet 5 inches center to center, carrying a 4-inch plank floor. The method of carrying the steps on the cantilever was a matter of some difficulty.

In the stands for the Philadelphia Ball Park, at Fifteenth and Huntingdon streets, a channel is used to form each riser. As, however, our risers are 18 inches, an I beam or a lattice beam would be needed to carry out the same scheme. The I beam would be nearly four times the required strength and the lattice beams very expensive. Moreover, the connections to the slanting upper chord would be difficult and costly. The risers were, therefore, carried on wooden joists, fastened by bent angles to the top chord of the truss and to two intermediate 7-inch I beams, 8 feet 4 inches center to center, which are in turn supported on I beams and the lattice girders used as bracing. The resulting connections are extremely simple and the weight small. As the load is likely to move horizontally, in a body, these intermediate 7-inch I beams, parallel with the upper chord, are tied up to the columns by means of diagonal rods; thus relieving the cross-girders of any transverse strain.

Owing to the general plan of the building, which forms an L, little fear was entertained that the trusses would sway in a horizontal plane. However, as the cost was slight, one panel in each wing was braced with 1-inch rods in the upper and lower chords of the trusses.



As mentioned above, the main floor, stairs, and dome of the grand stand, the bleachers, the fence, the railings in front of grand stand and bleachers, as well as all footings are of reinforced concrete and were made waterproof by aquabar,

The main floor of the grand stand offered an unusual opportunity for the economical arrangement of columns, as the space under the slope is of no value. The only governing conditions are the steel columns, 25 feet center to center, the foot of the slope, and the line of columns along the top of the slope; the plan adopted consists of steps with 30-inch tread and 8½-inch rise, carried on a slab of 4½ inches in minimum thickness, spanning between beams 12 feet 6 inches center to center. The seats are to be a form of theater chair. Each line of beams is carried on a row of columns. No girders are used in the typical construction. The number of columns in each row is such that the combined cost of concrete, steel, forms, and excavations is a minimum, for beams, columns, and footings, allowance being made for an increase of cost, as the number of units increases.

As the slab is reinforced in the direction of the steps, advantage is taken of the full area of the step to increase the effective depth of the slab. As the building laws require the minimum thickness in inches of a slab to be 0.6 times the span in feet, the slab would need to be 7½ inches thick. To avoid this, the steel was concentrated near the deeper portion of the step; ¼-inch round rods, 12 inches center to center, were run at right angles to these to care for the shrinkage and carry the load on the shallower parts. As the concrete in the step is isolated more than in an ordinary slab, the usual extreme fiber stress of 600 pounds per square inch was reduced to about 500 pounds. The concrete for the beams, slab, and steps was poured at one time, thus securing the economy of the T-beam. From the point where the bottom of the beam intersects grade to the lowest step, the slab is carried on a 6-inch wall, running below frost. This avoids any uplifts on the beam or slab, due to frost.

For the promenade at the top of the slope, the panels are nearly square. An investigation showed that the quantities of steel and concrete were slightly greater for a slab 12 feet 6 inches by 14 feet, reinforced in both directions, than would be required by the use of an intermediate beam, a girder, and a slab with single reinforcement. As, however, the space under this portion is to be used for stores and clubrooms, and the forms can be used but twice, the square panel was adopted.

The design of the bleachers offered somewhat greater difficulties. It was at first considered desirable to let the concrete steps act as seats. This would increase the number of patrons of the comfortable grand stand and do away with the first cost and repair of seats. But as the required seating capacity necessitated 42 rows of seats, the height of the bleachers, using 18-inch risers, would be 63 feet. The columns at once became the governing feature. As a compromise, the use of 2-inch by 8-inch plank seats on 2-inch by 3-inch sleepers was suggested. This reduced the height and the dead load, but did not do away with the necessity of bracing the columns and of fireproofing the bracing. The first of these plans has been used at Harvard and the Syracuse stadiums. In the former, steps of separately molded concrete were carried on steel I beams. The long concrete columns were braced by a steel framework. The speed required in construction and the difficulty of making neat joints forbade our using separately molded steps. Moreover, the steel work would have to be fireproofed, as one bleacher is to be a fireproof warehouse, and the other a garage.

In the Syracuse stadium the slope of the ground conformed to that of the steps, the columns were very short, and the dead load of less consequence. The steps were poured in place solid, as in this grand stand, no attempt being made to form steps in the under surface of the slab. The slope was, however, so great that the beams were poured first and notches left for the steps.

As the dead load was, in this case, a serious matter, and as the forms could be used twice, a design and estimate were prepared on the basis of making each riser a beam, 8 inches wide, carrying a 3-inch slab for the tread. The cost was excessive, and the following scheme was adopted:

Steps 7½-inch rise and 21-inch tread were found to give an excellent view of the field; 2-inch by 8-inch yellow pine plank, suported on special castings 3 feet

center to center, formed the seats, which are clean, comfortable, and easily taken care of. The castings which have lugs, to which the temporary boards for the riser forms are bolted, are nailed to the forms before any concrete is placed. This not only gives a rigid support for the seats and avoids all drilling, but also affords an easy and cheap method of maintaining the riser forms true to line while concreting. As there are over 7,000 of these castings, the unit cost was very low.

The minimum thickness of slab for the bleachers is 3 inches. The beams are 10 feet center to center. The construction differs from that of the grand stand in that girders are here used to lessen the number of columns, because the room below is of value. As the columns are very long and the loads comparatively light, our usual practice of resisting the unsupported length of columns to fifteen times the least side, and using 500 pounds per square inch in compression, was modified. The longest column is 27 feet in the clear and 16 inches square, giving a ratio of about 20 to 1. The unit stress was reduced proportionately and twice the usual longitudinal reinforcement used.

Great care was exercised in making the forms and pouring the columns, and no trouble was experienced from bursting of forms or from voids, although the whole was poured from the top.. The total fall was about 30 feet.

The concrete for the bleachers was poured in the following manner: The mixer was placed near the foot of the slope and about midway of the length. The material, which was delivered by teams, was charged into the mixer by means of an automatic dumping bucket, arranged to measure the ingredients A standard bucket hoist raised the mixed concrete to three successive levels as the work progressed. A scaffold connected the hoist with runways on the slope, and from these runways the concrete was deposited at the level required by means of wooden chutes. The steel, the castings for seats, and the riser boards were in place before any concrete was placed except in the columns. The operation of pouring girders, beams, and slab was, therefore, continuous. The forms were used again on the other bleacher. which, though longer, has the same slope and forms the same angle with the building line.

The construction of the main floor of the grand stand was carried out in the above manner, except that the concrete was poured from two levels instead of three.

The dome on the grand stand at the corner of Twenty-first street and Lehigh avenue is approximately 20 feet in outside diameter. It is composed of cinder concrete reinforced with round rods. No structural framing was used. About twice as much steel was used as was called for by the analysis. The cost of the steel is insignificant, the stiffer steel maintains its position better, and the factor of uncertainty in all arch and dome calculations is greatly reduced. A wind load of 30 pounds per square foot was assumed normal to the surface.

The theory followed in the design is that found in Prof. Green's book on "Elastic Arches." The assumptions are that there is no pressure at the crown, and that there is a varying outward thrust due to horizontal forces tangent to the curve and resisted by the tension in the horizontal rods. The bending moment, where the resultant pressure passes outside the middle third, is resisted by vertical rods. The whole is well anchored to the tower walls. As the greatest pressure on the concrete is about 200 pounds per square inch, cinder concrete was used.

It was originally intended to inclose the field with a reinforced concrete fence, 8 feet high. The posts were to be molded flat and stored until seasoned. The slab was to be 2½ inches, plastered on a metal lath with as large a moment of inertia as possible. When, however, the height was increased to 11 feet, the difficulty of preventing overturning, and the weight of the posts made this scheme impracticable.

The design adopted consists, as shown in Fig. 5, of a slab and substantial buttresses, formed and poured in place. It was not considered advisable to make the slab less than 6 inches thick, on account of the difficulty of pouring and pudlling the concrete.

The fence was designed to resist a wind load of 20 pounds per square foot. The factor of safety against overturning is about one and one-half, when the resistance of the earth is neglected.

The forms were removed at the end of twenty-four to forty-eight hours, depending on the temperature, and the surface floated before it had become very hard. Care was taken in puddling to keep the stones from the faces. The concrete was mixed by hand and raised in small buckets. An expansion joint was made at every third pilaster, that is, every 48 feet, to prevent bulging in warm weather. The reinforcement is sufficient to prevent cracking due to shrinkage. The section between expansion joints was poured at one time. The forms were used fourteen times.

The work was designed and constructed by the Wm. Steele & Sons Company, under the general supervision of Mr. J. M. Steele. Those more intimately connected with the details are Thomas Jamieson, C. E. McParland, C. H. Cramp, C. F. Gross, E. A. Steele, and M. Monaghan.

Credit is due the firm of Sax & Abbott for some suggestions on the design of the steel work. The steel work was constructed by Belmont Iron Works.

THE DECOMPOSITION OF PORTLAND CEMENT BY WATER.

The following experiments carried on by Dr. W. Muth, a German cement chemist, show that serious efforts are made by impartial observers to explain the differences that existed in the experiments of cement experts who undertook to explain the hardening process of cements. As known to our readers, all scientists, with the exception of Dr. W. Michaelis Sr. of Berlin, attribute the hardening to a process of crystallisation, whereas during the last ten years the Berlin savant advanced the theory that the hardening is brought on by the drying out of colloidal substances. of "mineral glues." He admirably described his theory in a number of papers and succeeded in convincing all unprejudiced minds of the correctness of his views.

However, the fact exists and is deeply impressed upon the minds of the scholars of the old school that crystals are formed upon decomposing cement with water. This process of crystallisation is more or less elaborate according to the conditions under which the experiments are made. Especially the varying amounts of water added to a cement caused differences of opinion, so that the advocates of the theory of crystallisation declared the results obtained by the decomposition of cements by large amounts of water not to be applicable to the conditions prevailing in actual practice in which a cement is gauged with a small amount of water.

The microscopic study of the cements decomposed by varying amounts of water reveals at last that crystallisation is possible only in the presence of large amounts of water, whereas the small amount of water

used in practice gives birth to colloids only. Thus the points brought forth in defense of the theory of crystallisation are rejected and the colloid theory is vindicated by these tests.

We abstract the description of Dr. Muth's experiments from the Tonindustrie-Zeitung:

A point of great interest to modern cement experts is the phenomenon, at first observed by Le Chatelier and Michaelis, that Portland cement shows an extraordinarily large increase of volume upon being agitated with large amounts of water, which prevents the grains from adhering one to another. Dr. Michaelis called this process "swelling." Miscroscopic investigation of the ensuing flocculent mass, however, teaches that this is not genuine swelling, but mainly a process of crystallisation. In the course of the decomposition of the cement by the water the surfaces of the minute grains of cement are covered with very thin long needle-shaped crystals which keep the grains far apart and become the cause of the increase of volume which suggests to the naked eye a swelling process. In addition to the needle-shaped crystals, several investigators observed plate-crystals of very regular hexagonal shape and also formation of colloids. One of these scientists, Professor Ambronn, described in an interesting manner the processes going on in the course of the decomposition of Portland cement by water, (Tonindustrie-Zeitung 1909 No. 28). In his experiment he stirred a small amount of cement powder with water, prevented evaporation of the water by a sealed cover glass and observed the decomposing process under the microscope. He found that in the beginning needle-shaped crystals and plate-crystals formed around the cement grains. Later also larger crystals of the shape of hexagonal prisms appeared, and finally a colloidal substance was formed. The conclusion he drew from this was that the setting of cement in practical use was likewise brought on by a process of crystallisation, whereas the final hardening process was caused, in his opinion, by the colloidal mass being completely filled out with crystals and thus being solidified. This deduction appeared to be correct. However, these observations were made upon cement decomposed by large amounts of water, that is to say under conditions widely differing from practical application. It was, therefore, more than likely that the decomposing process would go on in an entirely different way, if the conditions existing in practical operation would be observed.

This point, still open to discussion, induces me to publish a series of experiments which I made in the course of similar investigations and which possibly will lead to a clear understanding of the hardening process.

For comparative tests I allowed different amounts of water to act upon the same quantity of the same Portland cement in order to find the ratio of cement and water which would cause the maximum increase of volume. The Portland cement used for this purpose was burnt in a rotary kiln and showed normal setting and fair strength. Its chemical composition was the following:

Silica	21.29%
Alumina plus Iron Oxide	9.67%
Calcium Oxide	60.53%
Magnesium Oxide	1.46%
Calcium Sulphide	0.58%
Calcium Sulphate	3.39%

The experiments were made with 20 grams of cement in each case which were frequently agitated with varying amounts of water in flasks with sealed stoppers. By this process sticking together of the cement grains was avoided.

Flask	I	contained:	20	gram	Cement	and	4000	ccm	of	Water
"	II	"	20	"	"	"	1000	"	"	"
"	III	"	20	"	"	"	500	"	"	"
"	IV	"	20	"	"	"	200	"	"	"
"	V	"	20	"	"	"	100	"	"	"
"	VI	"	20	"	"	"	50	"	"	"

In all of the six flasks an increase of volume of the cement could be observed already after 5 days. In the case of experiment I this increase did not seem to stop before 28 days, while the remaining tests showed no further increase after 10 or 15 days. After a period of two months the following increase of volume could be stated:

Experiment	I	had increased in	volume	35	times		
"	II	"	"	"	"	4.0	"
"	III	"	"	"	"	3 8	"
"	IV	"	"	"	"	2.5	"
"	V	"	"	"	"	2.3	"
"	VI	"	"	"	"	2.1	"

Within this time small samples of the cement powder and of the liquid were taken out of the flasks at varying intervals and examined under the microscope. This study showed that during the beginning of the increase of volume in the case of experiments I and II needle-shaped crystals showing slight polarisation were formed in large amounts on the surface of the cement grains. At III and IV formation of crystals was not as distinct. However, strongly light-refracting, but non-polarizing drop-like formations became visible in the solution as well as on the surface of the cement grains. Needle-shaped crystals could not be detected in these cases. Experiment IV showed no change of the cement grains beyond a slight wear of the sharp corners.

After three days very thin well-formed hexagonal plates and a considerable increase of the formation of colloids could be observed at IV, V, and VI. The contents of flask VI showed cement grains surrounded by colloids on all sides, I, II and III showed at this time only a considerable increase in volume and number of the needle-shaped crystals. Hexagonal crystals, however, were missing entirely. A few days later the walls of flasks IV, V and VI began to cover themselves with distinctly visible crystals which increased in number and grew in time and finally obtained a length of 0.75 millimeter and a diameter of 0.25 millimeter. These hexagonal macroscopic crystals could be observed after 28 days in flask III and after 40 days in flask II. Experiment I, however, did not show any of these hexagonal crystals, not even after two months.

After a period of 2 months the microscopic picture of the samples in question was the following:

I. Very long thin needle-crystals surrounding the cement grains. Hexagonal crystals not present. Colloidal precipitates only in small amounts; the latter occur at cement particles not covered with crystals.

II. The thin needle-crystals are not as perfect as in flask I. Hexagonal plates are present in large amounts, partly free in the solution and partly grown together with the cement grains or surrounding them. In addition to this, an apparently colloidal, strongly light-reflecting substance forming clusters of small drops becomes visible.

III. Needle-crystals less frequent. Formation of hexagonal plates and of droplike colloidal precipitates increases.

IV. Needle-crystals rare. Colloids increase and adhere to the cement grains in the same way as the hexagonal plates.

V. Needle-crystals hardly visible. Large increase of the colloidal precipitate. Also hexagonal plates

increase in size and number. The colloidal substance surrounds the cement grains and is interrupted now and then by plate crystals.

VI. Formation of needle-crystals has ceased, while the amount of colloids has further increased. Hexagonal plates are very frequent.

The surrounding liquid was found to be saturated with calcium hydrate in all flasks except No. 1. In the latter case only 0.73 gram calcium hydrate was dissolved in 1000 ccm. Silica and alumina were not present in the solution.

Now I examined the crystals adhering to the walls of the flasks which could be recovered without much effort. Their shape and optic properties were those of the hexagonal system. They showed cleavage parallel with the base. Chemical analysis proved that they consisted of calcium hydrate adulterated with 1.8% of calcium carbonate and 0.47% of alumina. The calcium carbonate undoubtedly owes its origin to the unavoidable contact with the air upon taking the crystals from the solution, while the contents of alumina are to be explained by the adhering of minute particles of cement to the crystals.

The next point to be determined was, whether or not these miscroscopic hexagonal prisms were identical with the microscopic plates. This question had to be answered in the affirmative, as both belonged to the hexagonal system and as the formation of the prisms was preceded in every instance by the appearance of thin plate-crystals. Furthermore, both kinds of crystals were non-polarizing at right angles to the base. If the large crystals are heated carefully in a crucible, they break up into thin plates, possessing the same optic properties and having the same shape as the microscopic plate-crystals. Consequently there is no doubt that both are identical. Both form as soon as the solution is saturated with calcium hydrate. As long as the liquid is not concentrated, only needle-shaped crystals can be observed. Possibly these later decompose later as Ambronn believes. According to my own observation, however, no change took place even after nine months. In some instances crystals of calcium hydrate grow together with them and surround them, but they are never able to combine and form hexagonal plate-crystals as Gino Gallo states to have observed with puzzuolana; otherwise they would have to consist of calcium hydrate, which is out of the question as calcium hydrate can not crystallize from unsaturated solutions. The hexagonal plate crystals have been observed and described with certainty by a number of investigators who studied microscopic sections of hardened cement. However, their identity has not been revealed heretofore.

During my experiments, therefore, I observed the various products of the decomposition of cement described by Ambronn and succeeded in determining the conditions under which they were formed. If large amounts of water are used, only needle-crystals form in the beginning, which cause a large increase of volume. Later also small amounts of colloids precipitate. However, the more the amount of water approaches the small quantity used in actual practice for gauging a cement, the more the formation of needle-crystals disappears. In the same proportions the increase of volume diminishes, whereas colloids are formed in larger amounts. From this the conclusion must be drawn, that the setting and hardening are brought on alone by the colloids. Only after the hardening process has gone on for some time, crystals of calcium hydrate and needle-crystals are able to form and to contribute to the hardening.

CONCERNING THE CEMENT MILLS.

Alleging that a contract had been violated, the Texas Portland Cement Company filed suit in the Circuit Court for damages aggregating $1,500,000 against the Snow Steam Pump Company, and the International Steam Pump Company, the former, according to the petition, being a subsidiary concern of the International company, which has a branch office in St. Louis. The petition states that under the terms of a contract between the Snow company and the Iola Portland Cement Company, which later transferred its rights to the plaintiff by agreement with the defendants, the Snow company was to furnish materials for the construction of cement works near Dallas, Tex., for which the Iola company was to pay $167,500 in four equal installments. The plaintiff alleges that the defendants failed to carry out the terms of the contract, installing defective and inadequate machinery, which impeded the manufacture of the cement, and asks $1,000,000 actual and $500,000 exemplary damages.

* * *

Montreal— F. P. Jones, general manager of the Dominion Iron & Steel Company, has resigned to accept the general managership of the new Canada Cement Company, a new $30,000,000 merger of the cement plants in Canada.

* * *

Dr. E. W, Lazell, of Philadelphia, who is interested in the manufacture of cement, and who is at the Raleigh Hotel, Washington, D. C., said there was no working agreement between the cement manufacturing interests in this country, and they were doing business on a losing scale.

'It seems that our cement concerns are intent on cutting each other's throats," said Dr. Lazell. "One is trying to undersell the other, and the consequence is that there is no legitimate profit, no inducement to work for satisfactory results.

"When you consider the cost of manufacture of cement," said Dr. Lazell, "and the price at which some of the manufacturing concerns are selling the product, it should not be surprising that we complain of poor business."

* * *

The mills of the Louisville Cement Company are turning out 2,000 barrels of Portland cement and 800 of hydraulic every day, and it is almost impossible to find a sufficient number of laborers, although $1.65 per day is paid.

* * *

An insurance policy of $1,500,000 has been applied for on the life of George E. Nicholson, 49 years old, the cement manufacturer, by two of the companies of which he is head. Insurance men say this is the largest amount of life insurance ever sought at one time upon the life of one person in the history of insurance.

CHAS. A MATCHAM RESIGNS.

Chas. A. Matcham, president, The Fuller Engineering Co., Allentown, Pa., writes us that he has resigned as president of the above company and disposed of his interest to the company and intends hereafter to devote his time to the interests of the Allentown Portland Cement Company, of which he is vice-president and general manager.

THE NEW BONNOT PULVERIZER.

The Bonnot Company, of Canton, Ohio, manufacturers of Portland cement machinery, have just completed a new pulverizer, which represents a long step in advance in the art of grinding. This machine, a cut of which appears in their advertisement on page 2, grinds at one operation either limestone, clinker or coal, obtaining a fineness of 200 mesh. The wearing parts are few and they are so arranged as to be easy to replace. No separating is required, as only finished material is discharged, and all parts are so encased as to make operation practically dustless.

The exterior view of the pulverizer shows a heavy main base or frame with the screening chamber at the top, the two being connected by a hopper section. The base is a one-piece casting, making a self-contained machine, made heavy to give rigidity and reduce vibration. The base is recessed to receive the grinding ring, which stands vertically and is held by a clamp ring secured with bolts, having nuts on the outside of the machine. An extension of the main frame carries the large bearings for the main shaft.

The grinding parts consist of grinding track, rolls and head or driver. The rolls are 13 inches in diameter with a 7-inch face. There are 45 square feet of screening surface, and a fan is used in the screening chamber to deflect the material outward against the screens. The feeder is of the oscillating type and can easily be regulated by turning a small handwheel.

Great care has been taken in the construction to have no bearings inside, subject to the action of the material being pulverized. The machine is made for belt or direct motor connections, and has an average capacity of twelve to fifteen barrels of clinker and six to eight tons of limestone per hour. More than fifty of these pulverizers are now in operation in the cement plants of this country, grinding cement clinker and limestone. The results have been exceedingly satisfactory in economy of operation and general efficiency.

Such firms as the Diamond Portland Cement Co., The Omego Portland Cement Co., The Monarch Portland Cement Co., and others speak very highly of the Bonnot Pulverizer.

WELLER MANUFACTURING COMPANY TO BUILD A NEW PLANT.

Only three years ago the above company added an addition to their plant, increasing their floor space at that time by thirty thousand square feet, which it was thought would give ample room for a number of years.

As an indication, however, of the rapid growth of the Weller Manufacturing Company, and the demand for "WELLER MADE" goods, this Company has recently purchased a tract of land containing eight acres, located on the Chicago, Milwaukee & St. Paul R. R. at 44th avenue and Cortland street, Chicago, where a new modern plant is to be erected having a capacity of treble the present one.

The property acquired is now vacant, and it is the intention to erect buildings to house their machine shop, sheet metal, conveyor, bucket, wood-working and foundry departments of the most modern and approved type for that class of work.

The buildings will be of steel construction throughout, saw-tooth roof, with the exception of the foundry. They will be equipped with the most modern labor saving devices obtainable. The building for the storage of patterns will be fireproof throughout. There will be a modern office building, and the shipping-room will be designed for quick and accurate handling of all orders.

It is expected to have the plant ready for occupancy by May 1, 1910.

THE STANDLEY LAKE DAM, NEAR DENVER, COLORADO.

The Standley Lake dam, which The Kenefick-Quigley-Russell Company of Denver, Colo., are building for the Denver Reservoir Irrigation Company, nine miles northwest of the city of Denver, will be one of the highest earthen dams that has been built and will develop a reservoir capable of storing 100,000 acre-feet of water. The extensive irrigation system of this company covers upward of 200,000 acres. The system will depend for a water supply both on prior rights for diversion from various streams for direct irigation and on the storage of excessive flows in these streams. Standley Lake is situated on the west side of the South Platte River, while the lands covered by the system are on both sides of that stream. The system has been so developed, however, that it also will be possible to deliver water from that reservoir to lands on the east side should the necessity of such procedure ever arise.

The dam is located at a favorable site between two low hills about 9,000 ft. apart and with a valley between them having a maximum depth of approximately 150 ft., which is reached by gradual slopes from both sides. Upstream from the site is a broad basin particularly adapted to the storage of water under the conditions obtaining in that locality. The dam will be an earthen embankment, of which the plan and various cross-sections are shown in an accompanying illustration. It is contemplated that the ultimate structure will be 9,391 ft. long at the crest and have a maximum height of 141 ft. Under the contract that is at present being prosecuted, however, the crest of the dam will be 113 ft. above the lowest point in the valley, with a total length of 7,800 ft. The preliminary embankment thus to be placed will have a width of 20 ft. at its crest, with 3 on 1 and 2 on 1 slopes on the upstream, and a 2 on 1 slope on the downstream face, giving a maximum width at the base of 500 ft. It is located, as shown in the drawing, so a fill can be made on the downstream side to bring the dam to the final height of 141 ft. without interfering with the operation of the reservoir, This final section will have slopes similar to those of the preliminary embankment and resulting in an ultimate bottom width of 629 ft. The contract now being prosecuted involves the placing of 3,000,000 cu. yd. of material, while the final embankment will require a total of 4,500,000 cu. yd.

Before plans for the dam were prepared a most exhaustive examination of the character of the foundation was made by means of wash-drill borings and test pits. Several prominent engineers experienced in the construction of large earthen dams also were engaged to study the site and report their findings. From the data and opinions thus obtained it was concluded that an earthen embankment of this great height and length could be built safely and economically at the site. The results determined during construction have fully justified the original conclusions, so it is considered to be entirely feasible to carry the dam to the ultimate height proposed. The final section therefore will be added immediately upon the completion of the reservoir provided by the 13-ft. dam.

The wash-drill borings were made with a Cyclone well-drill outfit. On the axis of the dam a boring was sunk every 200 ft. to a depth of 20 to 80 ft., accord-

ing to the material encountered. On the upstream side of the center line of the embankment, within and just outside the limits of the latter, a number of additional holes also were bored in the lower part of the valley. Holes were placed at intervals of 100 ft. on the line of an outlet structure, under the dam, and directly downstream from the end of this outlet several scattering holes were located to determine the soil conditions in that vicinity. Over an area of about 100 acres upstream from the south end of the dam holes also were used to investigate the character of the soil. In all, over 60 borings were thus made, rendering available accurate data as to the character of the foundation of the dam.

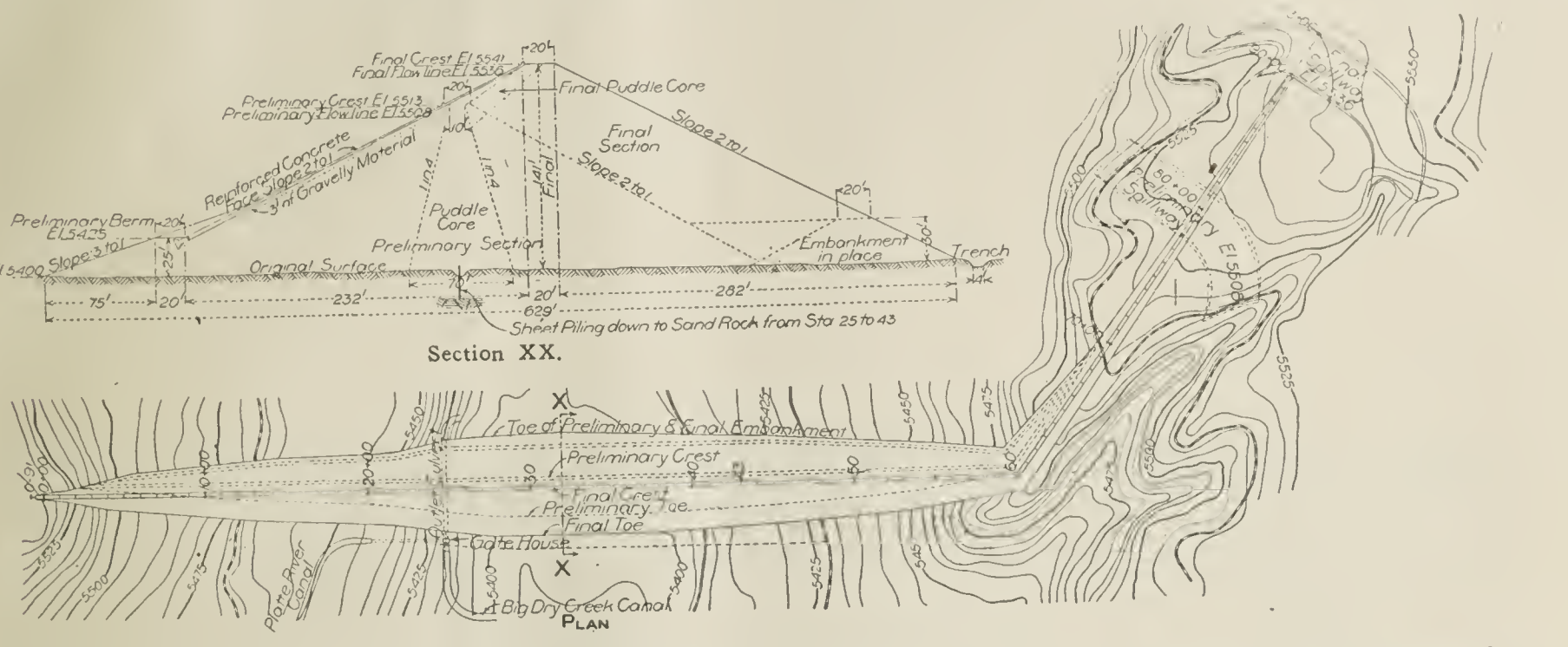
For about 2,000 ft. along the axis of the dam in the bottom of the valley the borings showed the surface soil to be underlaid with a stratum of gravel, or sand and gravel 18 in. to 3 ft. deep. This gravelly material is directly over a layer of standstone or shaley clay, which extended below the limits of some of the holes, while at other places it was only 2 to 6 ft. thick. Where the sandstone was penetrated blue and yellow clay was encountered. Towards the end of the dam, beyond the gravelly stratum, the lower reaches of the borings showed clays of various colors and character, except in three successive holes about half-way up the hill on the south side, in which holes the sandstone was passed through at a depth of 10 to 35 ft. Over the lower clays is surface clay and soil, all of which is quite hard. The occurrence of these materials as thus determined was considered to show that a properly designed and constructed earthen embankment could be built to the proposed height without fear of percolation through the natural ground at the site. The foundation available also is believed to provide ample bearing capacity to carry safely any loads that may be brought on it.

In addition to the wash-drill borings some sixty-odd test pits, ranging from 6 to 20 ft. in depth were dug in the areas from which it was proposed to borrow material to build the embankment. By means of these pits very satisfactory material was located adjacent to both ends of the dam. They also showed the soil conditions above the dam to be similar to those existing at the immediate site of the latter. Furthermore, it was determined from them that no apprehension need be felt of water percolating out of the reservoir.

Between approximately Stations 20 and 54, as shown in the accompanying plan, all sand, organic matter and such soil as was necessary to be removed to form a satisfactory bond between the foundation and the embankment was stripped over the entire middle third of the dam. Where sod and organic matter occurred over the remainder of the foundation they were also removed. The total depth of stripping over the middle third between Stations 24 and 54 averaged about 2 ft. in depth, while over the balance of the foundation it was only about 6 in. and in considerable areas no material had to be removed. The stripping was done with slip scrapers, grading machines and wagons. The material, except that taken from the middle third between Stations 26 and 47, was of such character that it could be placed to form the toe of the downstream slope of the ultimate embankment. Simultaneously with the stripping all ditches and muck holes encountered in the site were cleaned. Immediately before the embankment was started the area to be covered by the latter was plowed thoroughly to a depth of 10 in. to form a good bond between the natural ground and the fill.

To prevent percolation through the natural soil under the dam, cut-off trenches and a wall of sheet-piling was placed according to the conditions determined as the work progressed. The wall of sheeting was driven from Station 25 to Station 43 on the axis of the preliminary section of the dam to prevent any flow through the thin stratum of sand and gravel overlying the sandstone in this distance. The original intention was to use triple-lap Wakefield sheet-piling, but due to the very hard driving encountered enough United States steel sheet piling to make 1,800 feet of wall was used. The center of this 1800 feet of

Section XX.



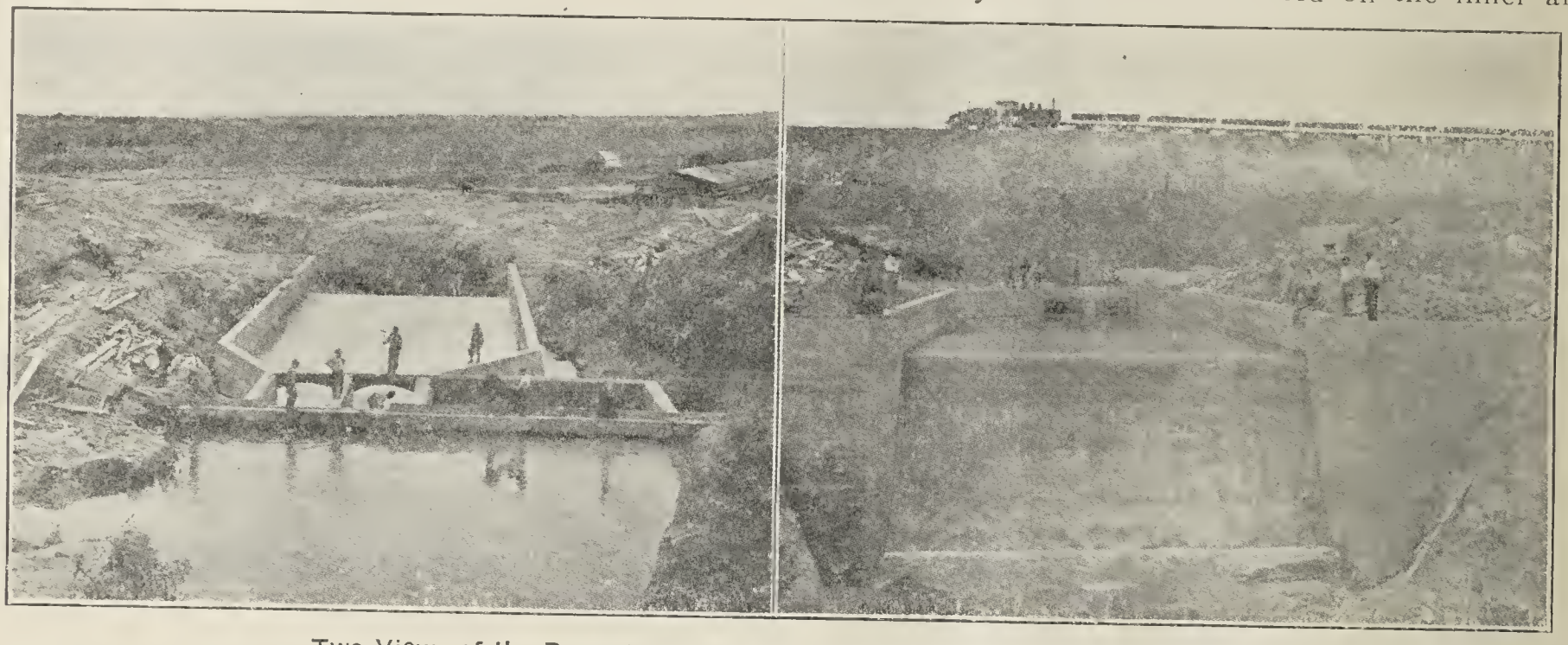
Plan and Section of the Standley Lake Dam.

steel sheeting was at the lowest point in the valley; at one end of the row of steel sheeting Wakefield piling was driven for 150 ft. and for 200 ft. at the other end.

An 1,800-lb. drop hammer mounted in leads on a moonbeam platform through which the penetration was secured was so hard that usually a pile would sink only about ¼ in. to a blow of the hammer falling 15 ft. On account of this condition the driving had to be done slowly and carefully to avoid damage to the piles. The plans provided that the piles should be placed in a trench 6 ft. wide at the top and 6 ft. deep and that their tops should extend at least 3 ft. above the surface of the ground at the edges of this trench, While this requirement was followed in most of the work, it was necessary in driving part of the timber piles to excavate a narrow trench to within 2 ft. of the level at which the ends of the piles stopped. The penetration secured along the row ranged from 2 ft. to 10 ft., but the top of the row was quite uneven, due to the irregularity of the surface of the stratum of sandstone into which the piles were driven. The piling was high enough, however, in all cases to afford ample bond with a puddle core wall in the dam.

100 ft. wells composed of lengths of 24-in. and 30-in. vitrified sewer pipe, the size depending on the location, were set in the row of tile. Each of these wells were surrounded on the sides and bottom with 1 ft. of sand and gravel of satisfactory character. The covers for the wells consist of reinforced-concrete slabs of such size and so placed as to prevent their movement. A line of 4-in. sewer pipe was laid from each well to the toe of the embankment. A ditch with a depth and bottom width of 4 ft. was built along the toe with a 5-ft. beam between it and the latter. At the lowest point in the valley the ditch was turned off to connect with the natural water course to which any drainage flow will be delivered.

The embankment is to contain at the middle a puddle core wall, approximately 70 ft. wide at the base and 10 ft. wide at the top, which has its center line coincident with the axis of the preliminary section of the dam. The puddle core is continuous with the cut-off trench, which extends the length of the dam on the center line of the latter and will be carried to the crest of the preliminary section now being built The method of construction employed to obtain this puddle core is in outline as follows: Earth dikes built of dry material were started on the inner and



Two Views of the Downstream End of the Outlet Culvert under the Dam.

From both ends of the row of tight sheeting a cut-off trench was continued on the axis of the dam to points well up on the sides of the hills. When in earth these trenches were excavated into impervious material, where the sandstone was close to the surface they extended down to it. They averaged 16 ft. wide at the top and 4 ft. deep, with such slopes as the material would take. At the south end of the dam beyond the limits of the sheeting the plans contemplated a second cut-off trench of similar size on a line about half way between the axis and the upstream toe of the dam. During the progress of the work it was found, however, that the hard, dense clay uncovered precluded the necessity of this additional precaution against the percolation of water under the embankment.

After the foundation had been prepared for the embankment, a system of drains was placed near the toe of the downstream slope of the final section in order to collect any seepage that may occur through the fill. This system embraces a row of 4-in. vitrified sewer pipe laid with open joints on a line 100 ft. inside of and parallel to the toe of the embankment for the entire length of the foundation. The tile in the row were placed to grades conforming to the slope of the prepared foundation. At intervals of

outer toes of the embankment. These are being continued up while the material dumped and spread between them is flushed with sufficient water to saturate the clay within the lines of the puddled core during the placing of the embankment. The clay of which the latter is being built is of such character that as far as the work has progressed it is formed into a compact, impervious mass in this manner.

A reinforced-concrete facing with its base imbedded in the finished dam is to be placed on the upstream slope of the embankment. This facing will take the place of the usual riprapping provided to prevent damage from wave action. It also will provide, in conjunction with the puddle core, against excessive percolation of water through the body of the dam, in lieu of the concrete core wall usually constructed for this purpose. With the various precautions thus taken to prevent a flow of water through or under the embankment it is believed that a stable structure will result.

At the time these notes were prepared the dike on the upstream side of the embankment had been built to a height of 70 ft., but none of the facing had been placed. The design of the latter had been developed fully, however, and will be described somewhat in

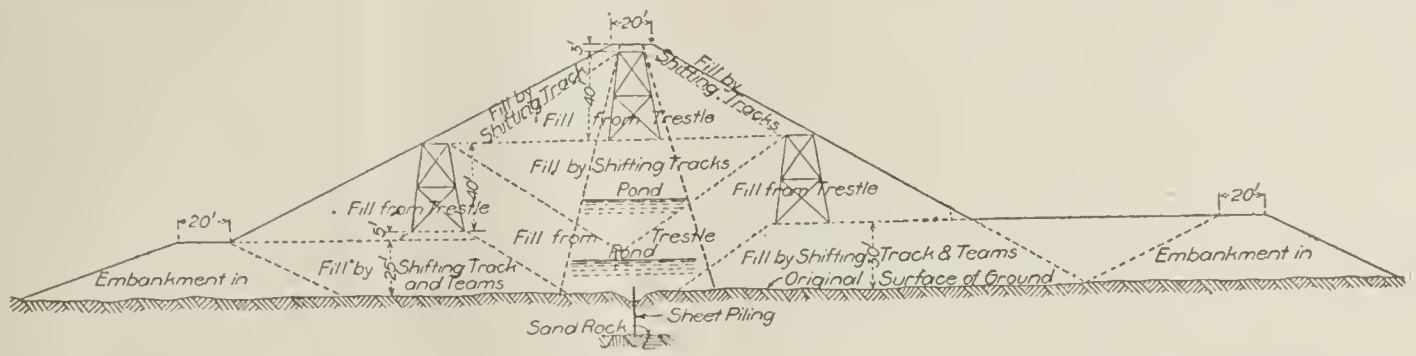
detail. The facing is to consist of separate strips, 5 ft. wide, extending from the top to the base of the dam at right angles to the axis of the latter. The thickness of these strips at the top will be 4 in., and at each 50-ft. interval below that it will be increased 2 in. to a maximum of 10 in. in the lowest section. At the base a broad bearing block is to be provided to take the thrust down the slope. This block will be imbedded in the top of a low embankment built along that toe of the dam previous to the inception of the present construction. It will be 25 ft. above the original ground surface at the middle of the dam and an average of 15 ft. above that level in the balance of its length. Over it the slope of the embankment will be increased from 2 on 1 to 3 on 1 to the bottom of the reservoir. The earth around this base also will be rammed and moistened, if necessary to secure a firm, solid bearing.

On account of the length of the surface of the lake back of the dam and the heavy winds prevailing in this region at certain seasons, special provisions against wave action have to be made at the top of the embankment. A barrier wall to act as the main buffer to the waves will be built in connection with the facing on a line 5 ft. in elevation below the crest of the dam. This wall, 9 in. thick and 18 in. high, will be normal to the surface of the facing. At intervals of 25 ft. it will contain 6-in. outlets to permit the escape of any water that finds its way over it. A parapet wall, 2 ft. high, placed at the top of the dam will serve as a final barrier to water entering the body of the dam due to wave action. Openings will be provided through this wall at 100-ft. intervals and the crest of the embankment will slope to them so any water splashing over may be drained back into the reservoir.

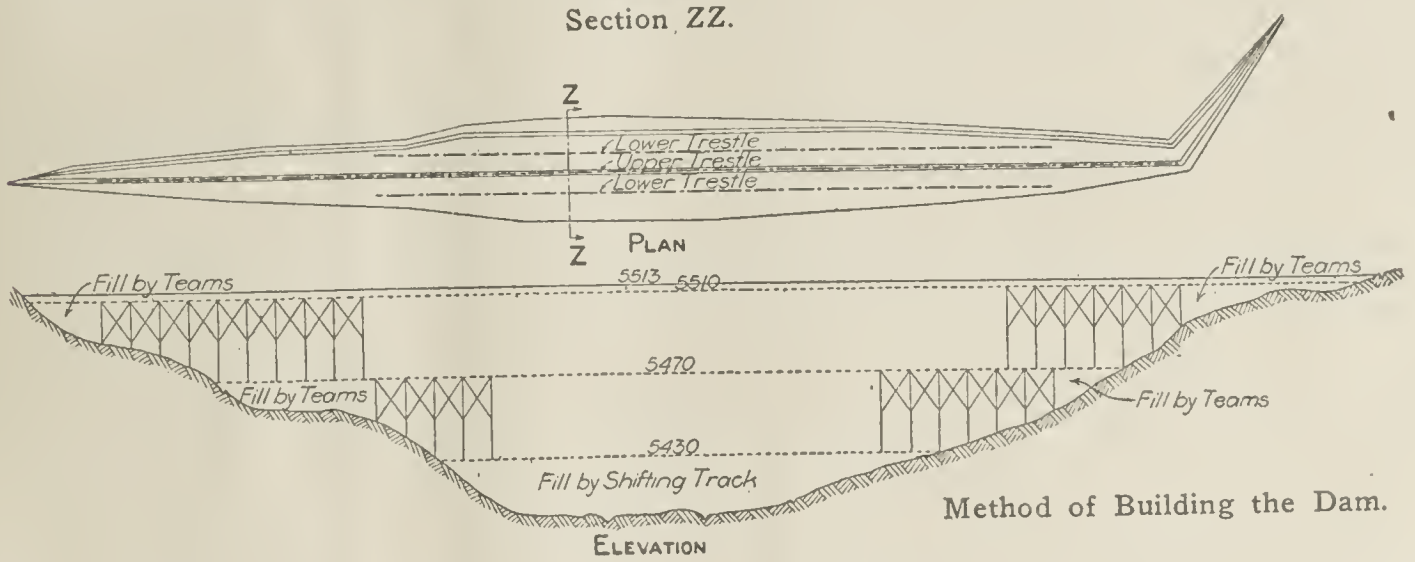
The plans permitted the use of either woven wire or expanded metal and steel rods as reinforcing for the facing, but the woven wire has been adopted. The proportions of the concrete for the facing, are specified as 1 part Portland cement, 2½ parts sand and 5 parts broken stone. All of these materials are required to conform to the usual standards.

Before the concrete facing is placed the upstream slope of the embankment will be brought to an even-plane surface. Then a 3-ft. layer of gravelly material is to be laid on the slope to provide a foundation for the facing. Unequal settlement of the latter is thus believed to be provided against in this manner, and by the design of the slab.

Provision is made for the concrete to be laid either in alternate strips, 5 ft. wide, or in two or more adjoining 5-ft. strips, with an expansion joint in both sides of each strip throughout its entire length. In case the facing is laid in alternate strips the reinforcement will be placed to project beyond the edge of each strip at least 6 in., in order to furnish a bond with the strips laid afterward. This same method of obtaining bond will be used when two or more adjoining strips are laid together, and in addition, pieces of tin will be used to separate the 5-ft. strips of the facing. By whatever method is adopted the 5-ft. strips will be laid continuously from the top to the bottom without any horizontal joints, unless it is necessary to make such joints to complete the lower section of the dam for the impounding of water. In fact, the present schedule is to complete the upstream slope to a height of 70 ft. as rapidly as possible, in order that the embankment may be given all the time possible to settle before the facing is laid. It also is probable that the facing will be carried to this height as soon as possible to permit the reservoir to be filled partially before the dam is completed.



Section ZZ.



Method of Building the Dam.

Water will be discharged from the reservoir through an outlet culvert extending under the dam at a point 2,475 ft. from the south end of the latter. This culvert consists of four lines of 48-in. cast-iron pipe, placed side by side, 5 ft. apart on the centers, in a trench excavated to an average depth of 11 ft. below the natural ground surface. The pipes are laid their entire length in a bed of concrete, 3 ft. 6 in. thick, which extends up to their horizontal diameters, filling the trench to within 2 ft. of the top of the pipe. The inlet ends of the pipes beyond the toe of the inner slope of the dam are in a heavy concrete headwall, From both ends of this wall wing walls extend 20 ft. out into the reservoir, and with a heavy lining on the bottom between them provide an entrance to the pipes below the natural ground level, forming the bottom of the reservoir. At the upper end of the lining of this approach and under the head-wall cut-offs are carried below the balance of the excavation to

prevent the passage of water along the bottom of the latter. At intervals of 60 ft. along the four 48 in. pipes are transverse concrete cut-off walls which extend 3 ft. below the bottom and into the sides of the trench and 5 ft. above the regular bed of concrete, thus furnishing a further guard against water following along the culvert.

The upstream end of each 48-in. pipe is fitted with a flap valve. These valves will be operated separately by means of the chains laid on the face of the dam to a winch at the crest. Around the downstream ends of the pipes is a heavy concrete wall forming the end of the culvert. Directly beyond this wall each pipe is fitted with a 48-in. Coffin gate valve having a rising stem. These valves are provided with operating standards mounted in a house over the end of the culvert. They will be utilized independently to draw water from the reservoir as required. The flap valves at the upper end of the culvert have been provided for emergency service in case of the failure of the gate valves. A filler gate is placed on each pipe directly back of the respective flap valve, in order that the latter will not have to be operated against a head.

At the downstream end of the culvert two of the 48-in. pipes discharge into a sitting pool, 140 ft. long by 40 ft. wide. This pool is in an excavation below the natural-ground surface and has a 6-in. concrete bottom laid on the hard clay uncovered; along the sides are heavy concrete walls extending 12 ft. above the invert of the pipes. The bottom is stepped up 6 ft. at a distance of 82 ft. from the ends of the pipes, thus forming a transverse buffer wall impounding a cushion of water which is designed to break the force of the discharge from the pipes before this wall is reached. The remaining 50 ft. of the length of the pool beyond the buffer wall has a flat bottom and at the end of this section is an overflow spillway with its crest 10 ft. above the invert of the pipes. The pool thus will be filled to this crest when the pipes entering it are discharging, so the force of the water will be entirely reduced before it goes over the spillway. From the latter the water will flow into a canal built to take the place of the natural creek channel below the dam.

The other two 48-in. pipes make a 90-deg. turn under the gate house, and directly outside this house are each connected to one of a pair of 54-in. riveted steel pipes. The latter will convey water to a second stilling pool located 450 ft. south of and 46 ft. in elevation above the downstream end of the culvert. From this pool the water will be discharged over a weir into a canal leading down the south side of the valley of Big Dry Creek. A branch from this canal also is to provide means of delivering water from Standley Lake to the lands of the company on the east side of the South Platte River.

A spillway for the preliminary height of the dam that is being built at present will be excavated 900 ft. back from the south end of the crest. This spillway is 300 ft. wide and has its bottom at the maximum flow line of the reservoir, 5 ft. below the top of the dam. Means of wasting water will be necessary only under a combination of most unusual conditions, but the spillway has been provided to meet just such a situation. It is built on a very flat grade through the hard clay so no lining will be placed in it. A flow discharged through it would pass into a natural water course leading away from the dam. When the final section of the latter is placed, as is ultimately proposed, this spillway will be filled and a new one built at the end of the final crest where it will discharge into the same water course.

The general contract for the construction of the dam was awarded to the The Kenefick-Quigley-Russel Company, of Kansas City, Mo., on Dec. 16, 1908, with the stipulation that the dam be completed to the 70-ft. height by March 10, 1910, and to the 113-ft. height by Nov. 17, 1910. The contractor immediately began placing equipment on the ground, so by Feb. 15, 1909, the entire plant employed was in full operation. Since then an average of nearly 8,000 cu. yd. of material has been placed in the dam each 24 hours with this equipment, the usual monthly estimates being about 200,000 cu. yd, In addition two subcontractors with teaming outfits also engaged on the work have brought the total amount of fill placed up to nearly 300,000 cu. yd. a month.

An accompanying sketch shows the method adopted in the construction of the dam. An embankment 20 ft. wide on top and 30 ft. high had been placed two years previously along both toes of the slopes of the ultimate 141-ft. height. At that time it was expected that the materials would be placed in the embankment by the hydraulic-sluicing process. The slopes of the present plans were adopted following a careful investigation also showed that the material available was to hard to be loosened economically by hydraulic giants. The fall from the point where the materials were located to the dam likewise was insufficient for satisfactory sluicing. For these and other reasons the dam is being built as a dry fill, except in the formation of the puddle core, as has been mentioned.

The bulk of the material is being excavated from borrow pits at both ends of the dam by steam shovels and delivered to place in standard-gauge dump cars. Teams are used in depositing the remainder,-which is located where the haul is short. The first lift of the dry dikes along the toes of the embankment were made to a height of 30 ft. by teams and wagons and by shifting toward the axis of the dam the tracks on which the dumpers operated. The outer slope of each of these dikes corresponded to the slope of the preliminary section of the dam and this first lift of each dike was made wide enough to bring its inner slope to the limits of the 70-ft. base of the puddle core.

Meanwhile teaming outfits were placing the embankment at both ends in such a manner that trains of the dump cars could be operated from the borrow pits over tracks at an elevation of 70 ft. above the bottom of the valley. This was done so that as soon as the dikes were brought to the 30-ft. level a pile trestle, 40 ft. high and carrying a single track at the 70-ft. elevation, could be built along the inner edge of each of them. Each trestle is located so material dumped on one side of it from the cars can be placed to the respective slope of the dam with a minimum amount of extra handling. The location also is such that material dumped on the inner side of the trestle can be manipulated to form the puddle core by keeping the application of water such that the material is actuated to the proper distance back into the dikes.

By shifting the tracks it is expected to fill the triangular section of the embankment determined by a line drawn between the inner corners of the tops of the trestle and 2 on 1 slopes from these corners towards the axis of the dam. The present scheme contemplates that after the 70-ft. elevation is reached a single 40-ft. trestle will be built on the axis of the dam. By filling from this trestle the embankment will be completed to within 13 ft. of the height of the preliminary section. The small remainder of the fill will then be placed by shifting the track at this elevation.

Two steam-shovel borrow pits have been opened adjacent to the north end of the dam, one on the downstream side and the other about 500 ft. upstream, that end of the dam being curved in that direction from the axis of the main section of the embankment. Material also is taken by steam shovels from a third pit located 500 ft. beyond the other end of the dam. The contractor has in operation one 60-ton Atlantic, one 80-ton Marion, and five 60-ton Marion steam shovels, two of which are located in each borrow pit. The material taken from the latter is dense clay of various kinds, while thin strata of sandstone have been encountered in places. No shooting has been required, however, and the faces of the excavaton stand practically straight, making quite satisfactory digging conditions for the shovels. The cuts were started at a working face of 12 ft., which has been increased in one pit at the north end of the dam to 32 ft., while the other pits will reach that depth as the work progresses.

The standard-gauge equipment used in moving the material from the borrow pits to place in the embankment embraces twenty 6-yd. and thirty 12-yd, Oliver cars and forty 12-yd. Western cars. The 12-yd. cars all have double trucks, steel frames, air brakes, and are arranged to be dumped by compressed air from the cab of the locomotive. Nine of the 12-yd. cars usually are hauled to a train, while fourteen of the 6-yd. cars are operated to a train. The contractor has on the work nine 45-ton standard-gauge locomotives which are used in spoil-train service.

Although the material from the borrow pits is excavated and handled readily, it is particularly difficult to maintain tracks on it in wet weather. An unusual amount of rainfall also has occurred in Colorado since the inception of this work, with the result that much trouble has been occasioned in keeping the equipment in service to its full capacity. In spite of these conditions the high average record already stated has been made.

The trestles on which the tracks are carried across the dam at the 70-ft. elevation has four-post bents spaced 15 ft. apart on centers. These bents are cross- and sway-braced and the trestle is braced longitudinally at the first-story level by two pairs of struts. Between the caps on the tops of the bents are also two pairs of 6 x 14-in. stringers which carry the ties of the tracks. The trestle for the dike on the upstream side of the embankment has been built as rapidly as possible in order that the slope of the dam formed by one side of that dike might be completed as quickly as possible.to secure the maximum amount of settlement before work is started on the concrete facing. This trestle was started from both ends with a traveling pile driver on each section to place the posts of the bents. As rapidly as the track could be laid the spoil trains were advanced out from both ends to deliver material into the fill. The connection between the two halves of the trestle was made the latter part of July and the dike was practically closed to the 70-ft. elevation on September 15.

Simultaneously with the work on this dike the trestle carrying a track at the 70-ft. elevation is being constructed along the downstream dike, starting at the north end of the dam. This trestle was carried ahead in the same manner, with the spoil trains operating to the end of the completed part of it from the downstream borrow pit at the north end of the dam. The upstream dike will continue to receive material from the borrow pits at both ends of the dam, in order that it may be built with all the speed possible. The steam shovels in the second borrow pit at the north end will deliver material for the downstream dike, the trestle for which was nearly completed across the valley on September 15. The fill for this dike also is nearly across the valley to the height of this trestle. When the two dikes have been closed at the 70-ft. elevation water will be admitted to the space between them and the puddle core carried up by dumping material from the trestles into the pond.

At the south end of the dam about 30,000 cu. yd. of embankment are being placed with teams and dump wagons by Messrs. Lamareaux, Peterson & Davis, of Omaha, Neb., under a subcontract. The material handled in this manner is clay obtained from a borrow pit on the top of the hill adjacent to the part of the embankment in which it is utilized. It is excavated and loaded into the wagons by elevating grader machines drawn by horses. The pit covers an area of 30 acres of fairly level ground over which the stripping was carried to an average depth of 4 ft. The center of this area is about 700 ft. from the center of the part of the embankment being made from it, the haul being slightly down-grade toward the dam. The contractor is operating two of the grading machines, with 14 horses to each machine, and 20 three-horse 1½-yd. wagons. With this outfit working 10 hours a day 37,000 cu. yd. of material were moved into the dam in July.

The wagons are dumped at the edge of the fill which is being made by them to form the end of the dam. Most of the material can thus be dropped where it will spill over the side and assume its angle of repose. The balance is pushed out from the top of the fill in order that the wagons may be operated most economically. This trimming work is done by hand and by Mormon graders.

In placing material in the part of the puddle core between the first 30-ft. lift of the two dikes a rig, consisting of a 3 x 5-ft. wooden blade mounted on one end of a wagon tongue with the other end of the latter carried by the front wheels of a wagon gear, was used to advantage. Two horses hitched in the usual manner drew the outfit forward and back at right-angles to the edge of the embankment and pushed the material over the side rapidly. Ordinary blade grading machines were used for the same purpose by the contractor who made the fill with wagons at the north end of the dam.

The wagon work at the north end involved 300,000 cu. yd. of filling, which was obtained from a borrow pit and placed under conditions similar to those existing in connection with the work at the south end of the dam. The contract for this work was awarded to Mr. J. A. Osner, who employed four elevating grader machines and 28 wagons in handling it. This outfit working 10 hours a day placed 53,000 cu. yd. in the embankment in July. The haul averaged 700 ft. and the material was almost entirely a hard clay, which the machines excavated readily.

The officers of the Denver Reservoir Irrigation Company are Messrs. Joseph Standley, president; T. B. Croke, vice-president; W. E. Goldsborough, vice-president and general manager, and O. J. Standley, secretary. Mr. Gildsborough has administrative charge of the various departments of the company, including supervision of the construction work.

The plans for the entire project were prepared by the hydraulic department of the Arnold Company, of Chicago, Mr. W. H. Rosecrans, chief engineer. Messrs. C. E. Freeman and A. H. Marshall, assistant engineers of that department, were engaged in the preparation of the plans. The construction work is being handled under the immediate supervision of that de-

partment, with Mr. Freeman as resident engineer. Mr. M. E. Witham was engineer in charge of the construction of the Standley Lake dam from the beginning of the investigations made at the site until he resigned on September 1 and was succeeded by Mr. Wm. M. Strong.

CONCERNING THE CEMENT MILLS.

For a whole dty twenty-five physicians, representing different insurance companies, were examining Mr. Nicholson. After it was all over, physicians declared he was in perfect physical health, and agents of the different insurance companies said the policy undoubtedly would be issued.

Mr. Nicholson is president and general manager of the Iola Portland Cement Company, the United Kansas Portland Cement Company, the Dixie Portland Cement Company, and the Iowa Portland Cement Company. He already has four insurance policies on his life aggregating $325,000, so that when the additional policies are issued he will have nearly $2,000,000 insurance.

Most of the amount was taken by the Mutual Life and the Equitable Life of New York.

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All parts of the country were represented at the annual meeting of the stockholders of the Northwestern States Portland Cement Company, at Mason City, Iowa, the other day, who met to hear reports of the year's business and to elect officers. Every available bit of machinery used to turn out cement running day and night, thousands of tons of the product in orders to be filled, over 400 men on the payroll; such was the burden of the report made by the officers.

The price of cement, however, is not satisfactory. So reported President Cowham, but that was due to a cement war which he hoped, he said, would soon be settled. Eastern men present said there was a revival of business in the east and that the coming year was scheduled to look better for business than any past year. The officers elected were: W. H. Cowham, Jackson, Mich., president; E. J. Breen, Fort Dodge, vice president; C. H. McNider, Mason City, treasurer; N. S. Potter, Jackson, Mich., assistant treasurer; W. H. L. McCourtie, Minneapolis, secretary; and A. C. Stitch, Independence, Kans.; T. H. Dinsmore, New York; J. H. McNair, Halstead, Kans.; W. W. Hawley, Huntington, Ind., board of directors.

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A belt conveyor for coal and shale has been installed at the plant of the Colonial Portland Cement Company, Wiarton, Ont., which is 1,285 feet long and 24 inches wide, and operated by a 25-horsepower motor. The management claim that a saving of 30 per cent in labor has been obtained by this addition to the plant. Numerous other improvements have been made of late to the Wiarton plant, in order to reduce the cost of production to as low a figure as possible. It is the intention of this company in the spring to install two additional rotaries, making the capacity of the plant 2,500 barrels per day. The president of the company is Mr. C. A. Buhrer, of Detroit, who hopes to make this plant one of the best to be found anywhere.

Spokane, Wash.—The People's Portland Cement Company has been incorporated with a capital stock of $2,000,000 by F. R. Clarke, John Vanderbergen, Samuel J. Babcock, and a number of others.

THE SETTING OF PORTLAND CEMENT.*

By H. K. G. Bamber, F. C. S.

My object in writing this paper has been to give to the members of the Concrete Institute a short resume of some of the results of research work in this direction done by manufacturers and others, more especially as applied to the more modern methods of manufacture.

I purposely give the practical side of the question the pride of place, as the interests of the members of the Concrete Institute, and in fact all users of cement, are more concerned with this branch of the investigation than with the other. It matters little to you what the exact formula may be representing the composition of the ingredients and their combination in the finished products so long as you have at your command a material which can be used under all conditions of your work, and positive information from the practical results of competent investigators in this field of inquiry as to the best methods to be adopted by the engineer and other users to insure successful work in the sometimes difficult conditions under which this work has to be carried out.

I do not propose to express any new theories, but in order that it may be seen how indefinite the present real scientific knowledge of this difficult subject is, and what insufficient and contradictory data the cement manufacturer has at his command when embarking on any practical experiment based on scientific theories, I will shortly refer to those which exist, and are most accepted at the present time.

It is well known that for the best cement the total percentage of lime (CaO) present, as found by analysis after decomposition of the various silicates and aluminates by solution and subsequent separation, is confined to very narrow limits—i. e., 63.5 to 65 per cent. The amount of silica (SiO_2) varies from 21 to 22.5 per cent., and alumina (Al_2O_3) from 5 to 6 per cent., so that whether the ratio of lime to silica is calculated on a percentage basis or in accordance with chemical equivalents, it approximates 2.8 parts lime to 1 part silica, the formula for which without assuming any definite combination, may therefore well be written as $3CaOSiO_2$, laying approximately the lime required in combination with alumina to form dicalcic aluminate, and any attempt to vary this ratio to any extent results in a material which has not the good properties of, and can not be designated as, a true Portland cement.

The percentage figures mentioned of 63.5 to 65 per cent. of lime may appear to many who are accustomed to the old specifications for cement, placing a maximum of 61.5 per cent. for lime, to be high, but many analyses of pure clinker taken from such kilns as are used for the old methods of manufacture, and which are presumably producing cement within that apparently low limit, show that for years the higher figure has been the percentage in all good cement clinkers, the actual fact of its presence in such quantities in the ground cement in part being cloaked by the accidental introduction of extraneous foreign matter derived as an uncombined residue from the fuel used for calcination.

These facts are mentioned, as they have an important bearing on the setting properties of cement.

Like the constitution of Portland cement, the theories as to the setting are also somewhat vague and uncertain; but it is generally assumed that the action

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*From a paper entitled "Some Notes Relating to the Setting of Portland Cement, with Description of Methods Adopted for Regulating the Same," read before the Concrete Institute.

is brought about firstly by the hydration upon the addition of water and subsequent crystallization of the calcium aluminates present, which occur with great rapidity, constituting what is known technically as the "initial set," causing cohesion of the mass of cement and the intermingled aggregate. This is followed by the hydrolysis of the calcium silicates, the latter being slowly decomposed and broken down into the more simple form of mono-calcium silicate, with the consequent liberation of calcium hydrate ($CaOH_2$), which being in excess of that required to form a saturated solution partially crystallizes out—this cycle of operations continuing over long periods during the hardening of cements.

These, then, are the hypotheses, correct or incorrect, which guide the cement manufacturer embarked on a field of investigation, or with which he endeavors to explain the various phenomena which present themselves from time to time during the course of manufacture.

The time allowed for consideration of these matters will not permit of a complete exposition of the many problems that confront the manufacturer, and it is proposed, therefore, on this occasion, to deal only with some of the points that arise in connection with the retardation of the setting time in order that the latter may be brought within reasonably controllable limits, and to endeavor to explain the irregularities that are sometimes found when testing the setting time and the soundness of present-day Portland cements.

A thoroughly well-made Portland cement clinker, ground to normal fineness, is always very quick-setting, almost equal to that of plaster of Paris, but this property of rapid-setting can be somewhat delayed by mixture of other foreign substances, as has been done accidentally until recent years, and in fact yet continued, with cement manufactured on the intermittent kiln system, now being rapidly superseded. By this method dry material of uniform and correct composition is calcined by mixture with from 40 to 50 per cent., or even more, of its weight of coke and coal, the ash from the fuel—about 12 to 15 per cent. of the weight of the fuel used—remaining mixed up with the calcined clinker. In most cases this foreign matter alone has the effect of prolonging the setting time some few minutes, but portions of the clinker removed separately and free from the fuel ash when ground to powder set almost instantaneously upon the addition of water, with disengagement of considerable heat due to the rapid chemical action.

It is difficult satisfactorily to explain why the admixture of the fuel ash should have the effect of retarding the setting time somewhat, unless it is that it contains an amount of sulphates derived from the oxidized sulphur compounds originally present in the fuel used, and these sulphates having a similar effect on the cement as the addition of a similar amount of gypsum—or it may be that owing to the less perfect burning of cement in the past cement always contains free lime in the amorphous, as distinct from the crystalline, condition—this lime being quickly dissolved in the water used for gaging, which, becoming saturated, prevents the solution of the calcium aluminates, and thus somewhat retards the set.

During recent years, and upon the introduction of new methods, more particularly that of the rotary kiln, none but this pure character of clinker is produced, containing practically no free lime in the amorphous condition—the system being such that the ash from the fuel the latter in quantity being in itself at least 33 per cent. less, to a very large extent passes away with the effluent gases from the kiln. This also applies largely to the sulphur compounds in the raw material and coal, which, being decomposed, pass out of the kiln as sulphurous acid with the other gases. The clinker thus is practically pure, and resembles those portions of picked uncontaminated clinker from the intermittent kiln previously referred to, and, like that, has when finely ground, an almost instantaneous set, and with a lime-content on anaylsis in both cases ranging between 64 and 65 per cent. It is thought that cement manufactured by the rotary process has a quicker initial set when untreated with any addition for the purpose of retardation than has the cement made by the older process, but this has been found to be an entire fallacy, since it is found that the pure uncontaminated clinker from an intermittent kiln is equally as quick setting as the pure clinker from the rotary kiln, the similarity being cloaked by the presence of the foreign matter from the fuel in the older process cement.

The realization of these facts was not apparent in the early days of the more modern methods, and the manufacturer was faced with what appeared to him at first to be a new difficulty, whereas in reality it was the obvious result of the more careful production of a pure material, which he had been accustomed formerly to manufacture, accidentally in a more or less contaminated condition. In ignorance of the above facts it was thought that perhaps the rapidity of the modern manufacturing process—more particularly the cooling down from the higher ranges of temperature of the calcined clinker, which was accomplished in a few minutes after reaching the maximum temperature—might be the cause of the apparently more chemically active condition of clinker manufactured by the rotary process; and very elaborate and costly experiments were carried out, extending over a long period, in which the calcined clinker after passing the clinkering temperature was kept at a red heat for a considerable time before final cooling, imitating, it was thought, the slower action of the old intermittent kiln process.

Unfortunately—like many others—this experiment, although carried out on a practical and commercial scale, either through the difficulty in regulating the supplies of clinker to insure a steady temperature of cooling, or through mechanical difficulties which the operation presented, was of a negative character.

Previous laboratory experiments in this direction had given great promise that more useful results might have been obtained, and undoubtedly indicated that during the calcination of cement clinker there are critical points of temperature of great importance, and well worthy the careful study of the scientific specialist.

Experiments were also carried out to test the concentrated action of carbonic anhydride upon these various aluminates, this being the principal ingredient in the atmosphere which, together with water, brought about the natural process of æration of cement. It was found that the aluminates containing the higher proportion of lime were less affected by this treatment with CO_2, than the lower aluminates, which it was thought might be the explanation why rotary cement was less affected by exposure to the atmosphere than cement made in intermittent kilns.

A very considerable amount of research work has been done under the author's supervision in connection with the properties of the various calcium aluminates to which the quick setting property of Portland cement is attributed. As already explained, it is thought that the more rapid cooling of the clinker probably has some chemical or physical effect on the

aluminates present, and in order to test this theory the dicalcic, tricalcic and tetracalcic aluminates were synthetically prepared in order if possible to test their setting properties individually when rapidly or slowly cooled from the state of fusion,

Unfortunately, such investigations are replete with difficulties, and it must not be forgotten that in examining these isolated components of cement their assumed properties when in a pure state may be entirely altered by the presence of other ingredients in cement reacting one upon the other. On the whole, the results in this line of research have been of a negative character, but the author mentioned this series as one of many such experiments carried out to indicate that highly scientific class of investigation the cement manufacturer is prepared to undertake to obtain a further knowledge of the properties of the material the manufacture of which is under his control.

Attempts have also been made to reduce the quantities of aluminates present by adjusting the composition of the raw materials, by increasing the silica content at the expense of alumina; but here, again, only partial success was met with, as it would appear that even small proportions of calcium aluminate present are sufficient to cause a very rapid initial set of the whole mass—in fact, as far as the author is aware, in no case, even where the raw materials were such that the calcined clinker contains a high percentage of silicates and a low percentage of aluminattes, is the initial set of such cement—untreated with retarders, other than very rapid—in fact, almost instantaneous.

In order to avoid the necessity for the addition of gypsum to the calcined clinker, which until water is added to the cement is present only as a mechanical mixture, it was thought that this addition might be made to the raw material previous to calcination, during which operation it might become evenly incorporated with the whole mass of clinker, but in practice this was found to be quite inoperative as to the maximum temperature of the kiln in the presence of silicate, etc., gypsum incorporated with the raw materials was decomposed, the sulphuric anhydride (SO3) being evolved and passing out of the kiln with the other gases, the remaining lime (CaO) combining with the silicates (clay): the added calcium sulphate in this case only having the same function as the calcium carbonate present, which gives up its carbonic anhydride (CO_2), which escapes from the kiln, leaving the remaining calcium oxide (CaO) to combine with silica and alumina (clay).

Various other suggested methods of prolonging the setting time of cement without having recourse to the mechanical addition of retarders to the finished cement have been attempted, such as the injection of solutions of the alkaline earths, and such like, upon the hot clinker during its passage through the cooler, but all these have met with only limited success, the results obtained being in many cases evanescent, and in others creating further mechanical difficulties in the grinding of the clinker, which render such processes physically and commercially undesirable.

At the end of the nineteenth century practically all the cement manufactured in the United Kingdom and in Europe was produced by the old method of calcination in intermittent or somewhat similar kilns, the product being a clinker having various degrees of hardness, ranging between the material thoroughly calcined at a temperature above 2,800° F. (at which temperature a thorough chemical combination takes place), and the material technically known as "half-burn," which latter is practically the raw material from which only the carbonic anhydride of the chalk or limestone and the water of hydration and organic matter of the clay has been expelled. Now it is quite easy to realize, seeing the very complex character of the chemical combinations which are thought to take place at the true temperature of calcination, how difficult, and in fact almost impossible, it must be to determine a formula which will correctly represent the chemical composition of even a uniform raw material calcined under such a wide range of temperatures as that represented by 2,800° to 900° F., at which latter temperature the volatile matters from the raw materials are expelled.

It is equally easy to realize that the physical conditions, and therefore the setting properties of the atoms forming this heterogeneous mixture, must be of a very varying character, depending largely upon the relative proportions of the heavy or more lightly burned clinker, or that of an intermediate character, present in the mass as removed from the kiln; the more heavily burned portions are considered the most valuable, more especially those portions of clinker which have not been contaminated with or fused by contact with the siliceous matter contained in the ash of the fuel; and the product of the present-day rotary kiln, calcined in small particles at a uniform temperature and in the absence of fuel ash, consists, as one would expect, almost entirely of this pure clinker. The only methods known to the ancients of retarding the setting time of this heterogeneous mixture of silicates and aluminates were by exposing such cement after grinding to long periods of æration or by the addition of gypsum in one form or other.

The first process is only successfully applicable in the absence of added gypsum, and the effect of prolonged æration of such cement is the absorption by the uncombined lime and the loosely combined silicates and aluminates, etc., of water derived from the moisture in the atmosphere, and subsequently carbonic anhydride from the same source. In this manner a considerable quantity of the material becomes carbonated and inert, depriving the cement of a not inconsiderable portion of its former chemical activity and thus causing a prolongation of the setting time.

It will be seen that such a method must be most imperfect in its action and requires a considerable length of time to enable the moisture and the carbonic anhydride in the atmosphere to find its way into the interior portions of the heap, by which time the outer portions will be considerably over-ærated and become practically inert.

It would seem that the action of the atmosphere is confined to the loosely combined or lightly burned particles of the cement, and that the thoroughly calcined particles are little affected by exposure to the atmosphere at normal temperatures, and this experience seems to be confirmed from the fact that cement manufactured by the rotary process, producing the pure clinker, when ground without treatment or additions to retard the setting time, will retain its original quick-setting property unimpaired for long periods when stored in bulk. Instances of this have occurred where cement having an almost instantaneous set at the time of manufacture has retained this property when kept in bulk, but otherwise, exposed to the atmosphere, for a period of two years.

It will be seen from this that the old method of simple æration in bulk to retard the setting time cannot be applied with any degree of the former success to the product from the rotary kiln, and this also seems to be evidence that the cement manufactured by the more modern process is of a much more stable and reliable character than that formerly put upon the

market. A cursory examination of the clinker produced by the two methods will, even to the uninitiated, be sufficinetly convincing on this point,

In view of the fact that this simple method of æration in bulk cannot be successfully applied to cement manufactured on the new system, many attempts have been made to accomplish the most important part of natural æration—i e., the absorption of water, by artificial means, such as passing the ground cement through a moist air or by blowing a moist air through the cement in bulk.

These methods have not been found to be wholly successful, firstly, from the physical and mechanical difficulties which present themselves by reason of the partial setting of the finest portions of the cement, with the consequent blocking of any apparatus used for the purpose, such as revolving drums, distributing disks, conveyor screws, and scrapers, and the like, and, secondly, in the author's opinion, for the much more important reason that, in order to accomplish the desired result in a short space of time, it is necessary to submit the cement manufactured by the rotary process (all of which consists of finely reduced particles of the pure calcined clinker) to a moist atmosphere at a comparatively high temperature, as distinct from the normal temperatures under which all the previous attempts at artificial æration have been carried out.

In order that this may be accomplished, and the cement submitted to a moist atmosphere at a high temperature, in which the action of the water vapor upon the particles of clinker may be rapid and effective, a process has been introduced in which advantage is taken of the peculiar construction of the mills chiefly used for completing the reduction of the cement to a fine powder in enclosed revolving cylinders, known in the trade as "tube mills," which contain as their grinding media a heavy charge of steel balls or flint pebbles.

The cement introduced into these mills for the purpose of finishing is in a coarsely ground condition, having previously been dealt with by some form of preliminary grinder, during which process, owing to the friction entailed, the temperature of the material has been rasied to a point ranging between 140° and 160° F. The friction due to the action of the attrition of the steel balls or flint pebbles against themselves, the sides of the mill, and the passing cement causes the temperature in the tube mill to be still further increased, and it is at this point where moisture is introduced in the form of a regulated supply of steam, which still further increases the temperature and enables it to be maintained at a point above 180° F., preferably about 200° F., at or above which temperature the operation is most successfully conducted, and the cement operated upon is made to take up uniformly throughout an amount of water, in practice about 1 per cent. or a little under, with which it combines chemically and which cannot be expelled except by ignition.

The thoroughness of the process will be realized when it is understood that the time of passage through the tube mill is about two hours, and that each particle of cement is being continuously submitted for that period of time to a moist atmosphere acting upon its surface, which latter is removed by the attrition of the balls or pebbles, exposing a fresh surface upon which a similar action takes place, until the whole leaves the mill at a temperature which has been gradually increasing until the operation is complete. In this way the operation of exposure to moisture is accomplished at a temperature above the critical point necessary for the purpose, and in such a manner that no mechanical difficulties present themselves in the blocking of the machinery or apparatus.

The facts mentioned in reference to the importance of carrying out the process at or above a certain temperature are not generally known.

Now let us return to the other method of retarding the setting time known to the ancients—i. e., the addition of gypsum to the product of the intermittent kiln during or after the process of grinding.

With this class of cement, containing already sulphates equivalent to about 1.5 per cent SO3, derived, as previously stated, from the sulphur compounds in fuel, it is generally enough to add 1½ per cent. of gypsum to obtain a slow-setting cement; the effect, however, in most cases in only transient, as it is well known that the effect of æration, even when the cement is packed, almost invariably results in such cement returning first to its original quick-setting condition before subsequently becoming slow setting, and largely inert through excessive exposure to the atmosphere This peculiarity of cements slowed by gypsum has been the cause of much difficulty to the manufacturer, and many conflicting theories have been propounded as to the cause of such reflex action.

A slow-setting cement containing 0.95 per cent. of SO3, of which only 0.35 per cent. is added retains this property of slow setting for long periods in commercial packages, as it is also known to do when stored in bulk.

It is difficult to give any definite chemical or physical explanation of the fact that the presence of as little as 1 per cent. of combined water in cement, which has been taken up at a high temperature, should not only in itself have the effect of appreciably slowing the setting time, but that when present in conjunction with even small percentages of gypsum the slowing effect of the combination is maintained.

The presence of 1 per cent. of combined water has also an enormous influence on the action of cement when tested for soundness under the boiling test, more particularly under the method by Le Chatelier and now usually adopted, by which method and with which apparatus it is thought the actual expansion of the cement can be measured.

By means of the steaming process described the proportion of gypsum required to be added to produce a slow-setting cement is much reduced, and if advantage be taken of the greater solubility of plaster of Paris ($CaOSO3½H_2O$) over that of raw gypsum (Ca OSO3 $2H_2O$) the quantity of SO3 introduced into a cement may be reduced to a minimum.

The author has referred to this subject on former occasions. Inasmuch as the effect of gypsum in retarding the initial set of cement depends upon the rapidity of solubility in the period immediately after the addition of water, and the quantity than can quickly be brought into solution (in which condition it is alone active, it follows that the form of gypsum having this property most developed will be the most effective. The quantity required to produce like results when plaster is used may be one-third less than with gypsum, and this is important in view of the known effects produced by the addition of gypsum to cement, more especially if the cement is to be deposited under water (more particularly sea water before setting commences)

Le Chatelier, in a paper read at the meeting of the International Testing Association at Brussels, describing the behavior of cements in sea water, says:

"By introducing important quantities of calcium sulphate into hydraulic cements it is possible to bring about their disintegration at more or less rapid speed;

and as a rule destruction proceeds faster when the material is in the sea than when it lies under fresh water."

It is important, in view of the chemical action which is said to take place between the added sulphate of lime (gypsum) or the soluble constituents of sea water, with the aluminate of lime in the cement, forming a compound said to be sulpho-aluminate of lime, that the amount of added gypsum should be kept as low as possible.

The action referred to by Le Chatelier is continually in evidence with all cements to which more than 2 per cent of gypsum, has been added to retard the setting time, when such cements are tested by the accelerated methods for determining the ultimate soundness, more particularly when they are subjected to the primary stages of that quantitative boiling test, which appears in most specifications, introduced by Le Chatelier himself and which bears his name.

This test was designed with the object of detecting rapidly any inherent unsoundness in cement, so that a knowledge as to the constancy of volume of any cement might be obtained previous to its use in the work.

To those who have had much experience in the orthodox working of this apparatus it is apparent that the conclusions drawn may frequently be entirely fallacious, and many perfectly sound cements thereby rejected, while others of doubtful quality for certain conditions of work are not detected.

In adopting this test the fact seems to have been entirely overlooked that many cements, more especially those containing over or about 2 per cent. of gypsum, are found to expand considerably during the primary immersion in cold water and may show but a slight further expansion during the second, or boiling, stage of the operation. Such cements will be passed as satisfactory by this test, and no doubt many will prove to be so, if allowed to harden before immersion in water. It would seem, however, that as at present conducted the test entirely fails to detect (unless a record of the expansion during the cold-water immersion is included) a cement containing an unsafe percentage gypsum, which cement may be required for work where the concrete is of necessity deposited under water immediately after gaging.

The period of immersion before boiling stipulated in the Le Chatelier test is a very important factor in affecting the results, and appears to be entirely arbitrary. It may be that certain cements, perfectly sound in cold and in boiling water, and especially those of a very slow-setting character, will fail to pass if boiled twenty-four hours after gaging, whereas at thirty-six or forty-eight hours, or even longer, the results may be perfectly satisfactory.

Now as to the causes of expansion of certain cements when boiled, this may be due to (1) an insufficient reduction and amalgamation of the raw materials, (2) incomplete or irregular calcination, or (3) a predominance of small unground particles of clinker in the finished cement. The Le Chatelier test is designed to guard against the results of such irregularities in the course of manufacture, and as regards points 1 and 2 is useful and effective, as unsoundness due to either of these causes may subsequently develop, causing disintegration. The expansion under these circumstances is probably due entirely to chemical causes, resulting either from unbalanced proportions of the raw materials, possibly also in an unsuitable mechanical condition, refusing to form during calcination a chemical combination of the same uniform character as would be the case if chemically balanced and thoroughly amalgamated; or, given a satisfactory raw material in all respects, the expansion on boiling point may be due to the fact that during calcination the raw material, either wholly or in part may not have been brought up to the requisite temperature at which the principal compounds constituting Portland cement are formed.

The expansion, however, due to the third cause—i. e., the presence of unground particles of well-manufactured clinker—comes under a different category, for the material causing expansion is of identical composition, and having the same chemical and physical properties as the finer ground portions of the cement, which latter, per se, are entirely free from expansion when boiled. The cause in this case is rather more of a physical character than a chemical one, although it must be admitted that the hydration of the particles of clinker at the high temperature, which in the author's opinion is the cause of the expansion in this case, is a chemical process.

It is evident that the mere reduction of the clinker to a fine powder does not in any way change the chemical composition of the cement, and if any difference is noticeable under the Le Chatelier boiling test between a finely ground and the same coarsely ground clinker, the former being perfectly sound and the latter showing expansion, this expansion must be due to the action of water at a high temperature on the particles.

In the author's opinion the conclusions drawn from the results of tests under the Le Chatelier method, brought about through this latter cause, may be misleading, because it is assumed that these particles causing expansion consequent upon hydration at a high temperature will equally expand at normal temperatures, which has yet to be proved.

From experiments it would appear that the larger particles of clinker remaining even in a commercially finely ground cement, which are hydrated with expansion when in contact with boiling water under the Le Chatelier text, are also hydrated, and perhaps also with expansion, by contact with steam at a high temperature, although in a comparatively dry condition, during the process of grinding.

This would seem to be the logical reason of the fact that while cement manufactured from clinker chemically well-balanced and thoroughly calcined will expand when submitted to the Le Chatelier test, it will not expand under the same conditions if it has been previously treated by the hydrating process.

Attempts have been made to use other materials for regulating the setting time, such as calcium chloride, sodium carbonate, etc., but as far as the author is aware these methods have not proved commercially successful. At the present time the processes employed are practically confined to watering the clinker, hydrating by means of steam during grinding, and the addition of gypsum. With these methods indivdually, or with a combination of them, cement can be produced having setting times suitable for all requirements.

Although the methods described make it possible to produce cement with definite setting properties, it must be remembered that the activity of the chemical process of setting is dependent upon the hygroscopic condition and temperature of the atmosphere or surrounding conditions under which concrete work is being carried out, a high temperature and a dry atmosphere tending to increase the rapidity of the set, and a low temperature and a moist atmosphere decreasing it.

NEW CEMENT PLANTS TO BE BUILT.

The Macdonald Engineering Company of Chicago, ave been awarded a contract for the erection of a ement storage plant for the Dewey Portland Cement Company of Dewey, Okla., which is a unique de-arture from the usual method of storing bulk ce-ent.

The plant will consist of four reinforced concrete ylinders 30 feet in diameter and 80 feet high. he inter-spaces between the four cylinders will be sed as a separate bin and a series of four smaller ectangular sacking bins will be built on the outside iameter of the cluster. Altogether there will be ten ndependent storage bins, giving a total capacity of bout 75,000 barrels. A special sacking department vith warehouse and shipping-room crossing the ship-ing tracks will also be built, using reinforced con-rete for the entire structure.

The foundation will be pierced by two conveyor unnels, through which a screw conveyor system will e installed for drawing the cement from the bottom f the storage. On the roof of the tanks, a cupola, r "texas," will extend the full length, which will ontain a screw conveyor for distributing the cement o the bins. At the discharge end of each basement onveyor in the lower tunnel, a steel elevator leg will e erected for the elevation of the cement to the up-er conveyor and to the sacking bins. Conveyor con-ection will be made with the warehouse to the pres-nt plant, so that all cement coming from the mill vill be passed direct to the new storage.

Work has already commenced on the foundation, nd the contractors expect to have the building ready or the machinery by the middle of January.

* * *

The International Portland Cement Company, an Arizona corporation with a capital of $2,500,000, pro-oses to construct a Portland cement mill west of he city of Juarez, State of Chihuahua, Mexico, op-osite El Paso, Texas. The company possesses 2,-00 acres of property which includes all the raw ma-erial for the manufacture of Portland cement in the icinity of Juarez.

The shale is exposed for its entire thickness of bout 1,000 feet, it rises to a height of approximately 00 feet and extends about 3,000 feet.

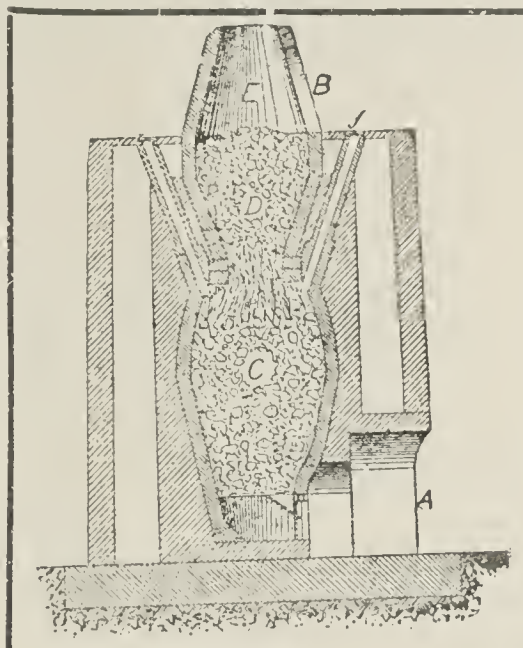
A remarkable feature is the existence of several eds of pure limestone gravel on the surface of the round, varying from 60 to 100 feet in thickness and overing about five acres of ground. This gravel aries in size from small pebbles to a size passing a -inch ring, in using this material the installation of lasting, drilling and crushing equipment will not be ecessary.

Analysis of limestone. Calcium carbonate, 94.76; ilica, 2.40; iron and alumina, 2.69; magnesia, .15. hale analysis: Calcium carbonate, 23.93; silica, 6.08; iron and alumina, 16.28; magnesia, 2.18.

This shows that a good quality of Portland cement an be made in proportion of 1 to 3. Water is found n abundance at a depth of 60 to 100 feet or pumped rom the Rio Grande river, two and one-half miles rom the property. Coal or oil will be the fuel. With he present prices of cement in Mexico netting about 2.50 U. S. currency at the mill this proposition of-ers an excellent opportunity for investors. Mexico nports about 1,250,000 barrels of cement annually. hus a Portland cement mill will have a market for s product. Mr. W. A. Haggott is interested in this ompany. The offices are at 1327 Commerce build-ng, Kansas City, Mo.

* * *

Allentown, Pa.—The Morgan Portland Cement Company, recently organized with a capital stock of $1,500,000, has purchased ninety-eight acres of land and secured an option on nearly as much more. Chemical analyses of the stone found on the property have been made by Lathbury & Speckman, of Philadelphia, and it has been found highly satisfactory. The company is now in the market for machinery and equipment of all kinds. The officers are: R. J. Hester, president; H. L. Burtley, vice president and treasurer, and E. W. Morgan, secretary. The directors are Hon. Thomas B. Morgan, Harry W. Davis, R. J. Hester, H, L. Burtley, H. C. Bedford and Andrew C. Wylie. It is expected that construction work will be commenced early in the spring and that the plant will be completed in the fall. It will have a daily capacity of 2,000 barrels.



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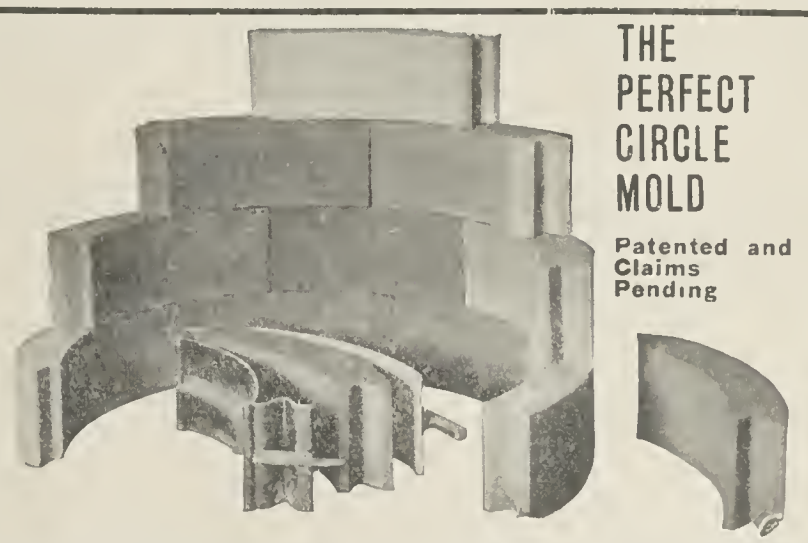

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The circle mold is built of No. 10 gauge sheet steel, reinforced with T-Iron. The molds are 8-in. high, 4-in, thick, making them strong and durable. These curbing blocks can be made on the ground or floor, or can be made on wooden pallets. Those in the concrete manufacturing business cannot afford to do without one of these molds, as all up-to-date concrete plants are equipping themselves with one or more of my curbing molds, for they all see at a glance their importance and utility, simplicity in operation, durable construction, and lasting qualities in products, as well as completion of a well equipped plant, showing the ability of a man's occupation or business. These molds are no experiment but an up-to-date invention, practicable, durable, simple and useful, and are only appreciated by those who have them in store. Selling at a price within reach of all. The output of these molds is grater than can be produced on any other mold, thus reducing the labor and cost of making the products, and also increasing the **Profits.**

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